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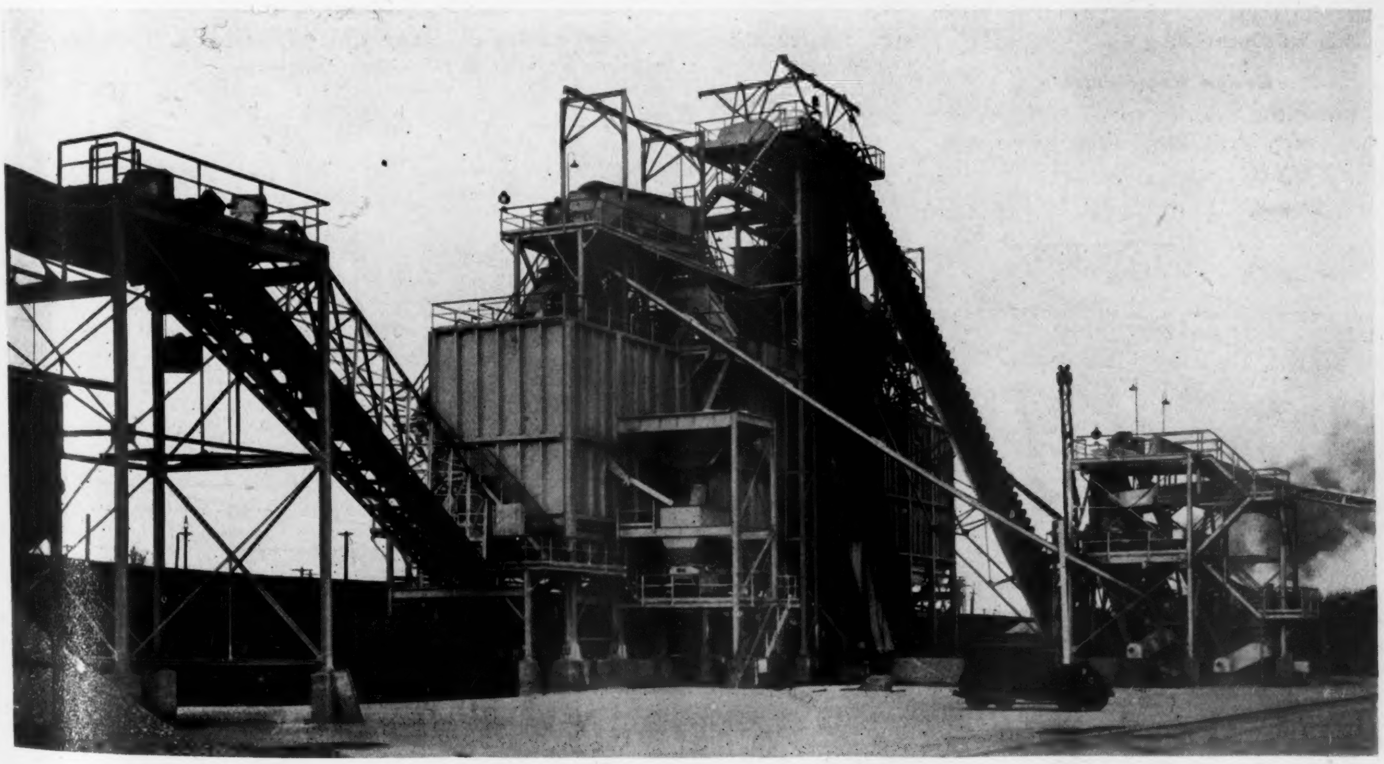
An Outstanding New Sand and Gravel Plant

Curtis and Hill Gravel and Sand Co. Has a Real Sand and Gravel "Factory" Near Philadelphia

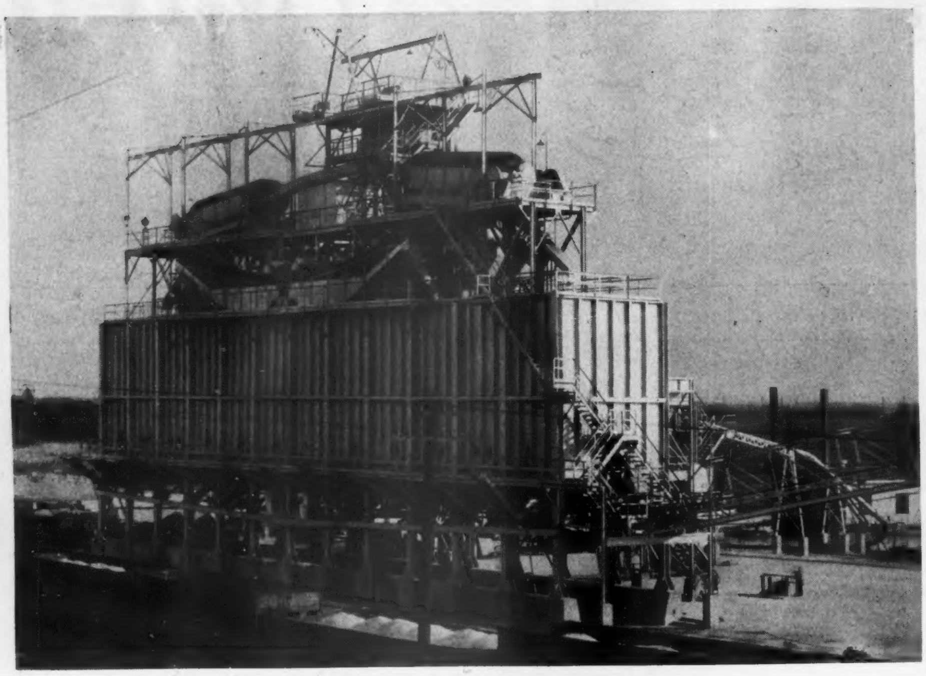
By A. R. Amos, Jr.

PENNSYLVANIA has two particularly good sand and gravel deposits at opposite ends of the state, one in the vicinity of Pittsburgh and the other at the eastern extremity along the Delaware river north from Philadelphia. In the latter location during 1931 an outstanding new plant was built by the Curtis and Hill Gravel and Sand Co. This plant is located along the Pennsylvania railroad in the Morrisville, Penn., section and in the center of a market justifying large capital investment to insure a plant capable of continuously supplying a large volume of quality material. Requirements for Pennsylvania and New Jersey highway work, building construction in the areas of which Philadelphia and Trenton are centers, and municipal and railroad improvements offer an opportunity for large scale production.

The deposit lies between the Morrisville yards of the Pennsylvania railroad and the Delaware canal. Under about 6 in. of overburden lies a bed of sand and gravel which has been tested to a depth of 70 ft. by means of over 40 drill holes. The present water level indicates that approximately 80% of the material is below water line, with an easily caving formation, ideal for hydraulic dredge excavation. Sand particles are sharp and suitable for use in concrete, while the gravel is satisfactory for aggregate. The gravel runs largely below a 5-in. ring size, but in some strata it ranges up to 10 or 12



Main screening and washing plant; scalping and crushing plant at right and storage conveyor at left



General view of main bins

Storage yard and main plant at left

in., with occasional pieces up to 36 in. in maximum dimension.

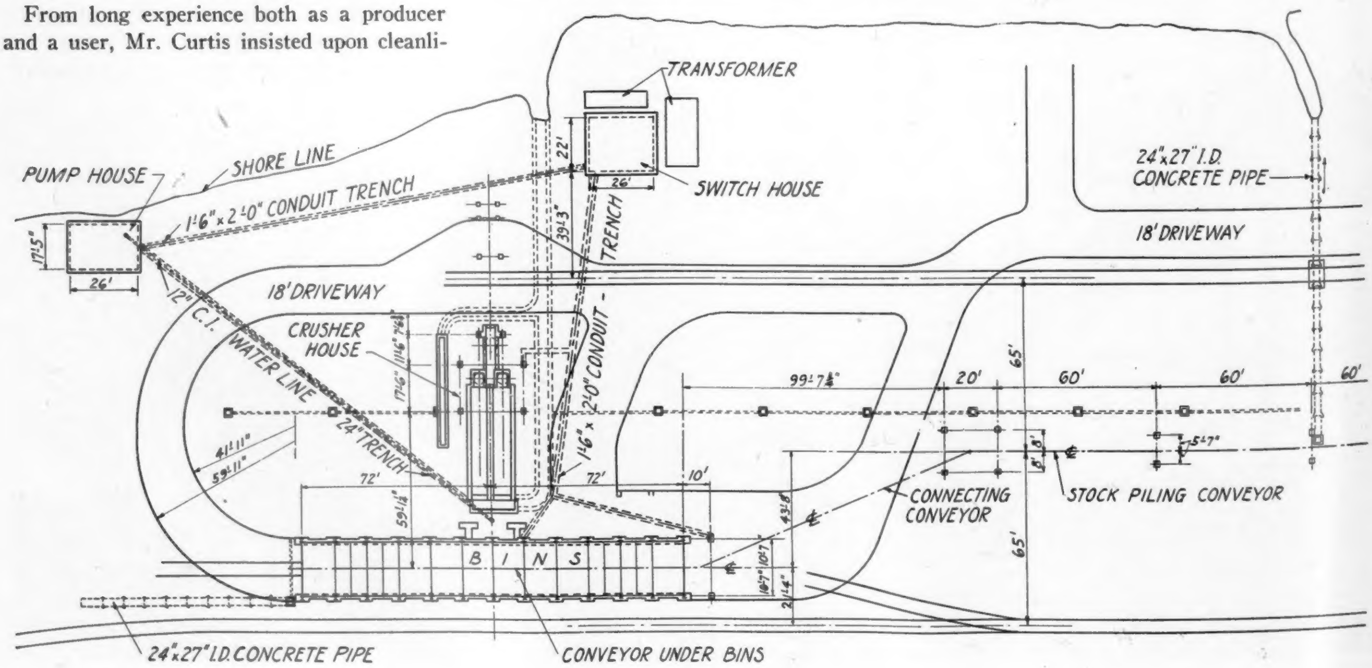
Design Requirements

From long experience both as a producer and a user, Mr. Curtis insisted upon cleanliness of product as a primary requirement, which is reflected in the unusual number of washing stages. The incoming material is first soaked and scoured in the dredge pump, pipe and delivery flumes; second, it is agitated on the vibrating scalpers; third, the soaking and agitation are continued in the digging elevator sumps; fourth, clean water is added by high pressure sprays driving into the mixing box at the point of the elevator discharge; fifth, a further scouring in rotary screen scrubbers with a 5-in. spray of clean water; sixth, rinsing with clean water in chutes and drags; and, seventh, final rinsing over perforated chutes after leaving bin gates and before entering cars or trucks. Of further help toward this end are the double-hoppered, self-cleaning bins.

A second requirement was compactness, since the generous depth of the deposit and its proportional high value per acre called for a minimum of plant area. This led to discharging the material directly into the plant from the dredging elevators with the gravel scalped out immediately from the pump discharge. This layout not only saves space as compared with a dewatering bin and belt conveyor to the plant, but also saves labor due to the smaller operating area.

A third requirement was to obtain an unusual degree of flexibility without sacrificing the simplicity which goes with a few units, each of large capacity, closely fitted together. Duplex plant design was a logical solution, permitting as many as four grades of sand and six sizes of gravel to be produced and stored with separate storage capacity for two additional sizes of gravel formed by mixing in chutes above the bins.

A further requirement for ample storage capacity led to the installation of bins of 5000 tons capacity and a long stockpile storage served directly from the plant by belt conveyors. These conditions were in addition to the usual requirements of low operating cost, high mechanical efficiency, and minimum maintenance.



Arrangement of underground lines

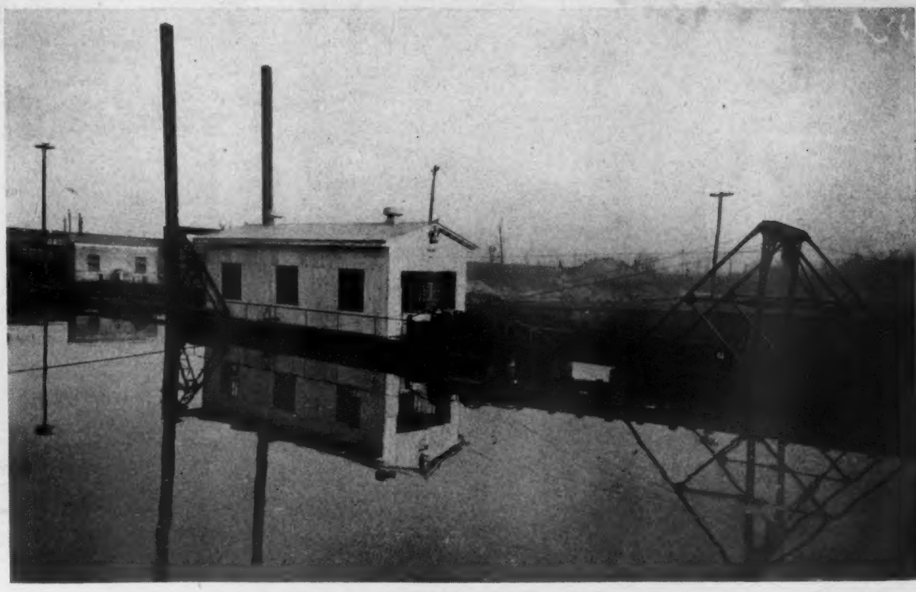
Everything indicated that the plant should be located at the west end of the property. Facilities already existed here for loading and storage tracks, heavier burden and thinner gravel beds existed, and large scale grading was unnecessary due to the availability of a long, level area previously occupied by car storage tracks. Additional advantages included the possibility of locating the pump house and sub-station close to the main structure with short length pipes and waste-water tunnels, all below the ground and avoiding obstructions to truck movement as well as improving appearances.

For the desired initial production of 400 tons per hour, with most of the material below water level and a constantly increasing delivery distance, a hydraulic dredge and pipe line was selected for excavating and conveying.

Dredging

After a careful consideration of the various designs of hydraulic dredges, a Hetherington and Berner sectional steel hull type with a Swintek ladder was selected. The detail design was thoroughly studied in order to secure the last word in continuous maximum low cost production, safety, ease in field assembly, and a clean-cut layout.

The dredge structure includes a main hull having a well at the forward end to accommodate the ladder and two pontoons ahead with a frame to support the ladder, these being connected to the main hull by laced struts, with pin hinges for flexibility. The main hull is 70 ft. long by 26 ft. wide by 5 ft. deep and is composed of six rectangular sections, each containing two water-tight compartments with a deck manhole for each

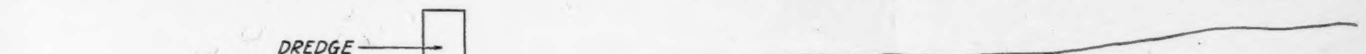


Dredge and forward pontoons supporting screen nozzle ladder. The spuds are an unusual feature for a suction dredge

compartment. The forward well is 12 ft. long and 12 ft. wide. The sections are of heavy welded steel plate construction, asphalt painted inside and out, and are joined together by bolts in reamed holes using lead washers with the seams covered by electrically welded cover strips. Each section is amply braced and the completed assembly is a rigid hull with the 12 water-tight compartments providing a high safety factor. A complete shop assembly of the hull was made before shipment in order to insure a perfect field job.

More than half of the weight of the ladder is carried on the two forward pontoons, which are 27 ft. by 9 ft. by 4 ft. 9 in. in size and are located 10 ft. apart and 20 ft. ahead of the main hull. These pontoons are also of welded steel plate construction and support a structural steel gantry frame mounted across their forward ends. The gantry consists of a cross girder supported by latticed columns and braced by heavy angles. The stringers connecting the pontoons with the main hull are latticed girders fastened to stringers on the main hull through hinged pins, allowing a free vertical movement when digging and not transmitting the stresses to the hull itself.

The ladder is a 50-ft. "Swintek" type



General plan of plant of Curtis and Hill Gravel and Sand Co.

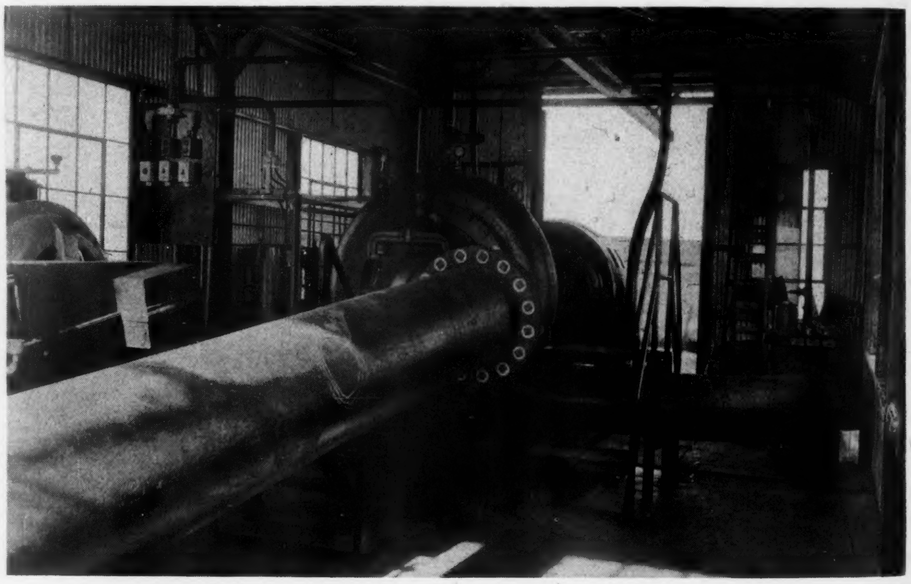
Storage yard with concrete floor. The material is reclaimed by a clamshell crane

manufactured by the Eagle Iron Works. It consists of a heavy structural steel framework with a track for guiding an endless traveling chain which acts as a continually moving screen past the suction nozzle. The openings in the chain are designed to reject boulders too large to pass through the pump and at intervals the chain has special links with cross bars which carry oversize pieces on the chain until they are discharged at the hull end of the ladder. This type of ladder with its constant digging action and rejection of oversize pieces permits practically continuous operation even with a large percentage of stone and cemented strata. To secure the high tonnage desired, an 18-in. nozzle and suction pipe and a relatively high flow velocity are used. The chain, sprockets, track liners, and nozzle are of manganese steel to withstand abrasion, and a new and improved type of automatic tightener maintains the chain tension. The ladder trunnions are attached to heavy steel I-beams rigidly secured to the main hull at the aft end of the well. A 40-hp. double squirrel-cage motor drives the ladder through a V-belt drive to the first gear shaft, and a friction clutch is provided to disconnect the power quickly if this should be necessary.

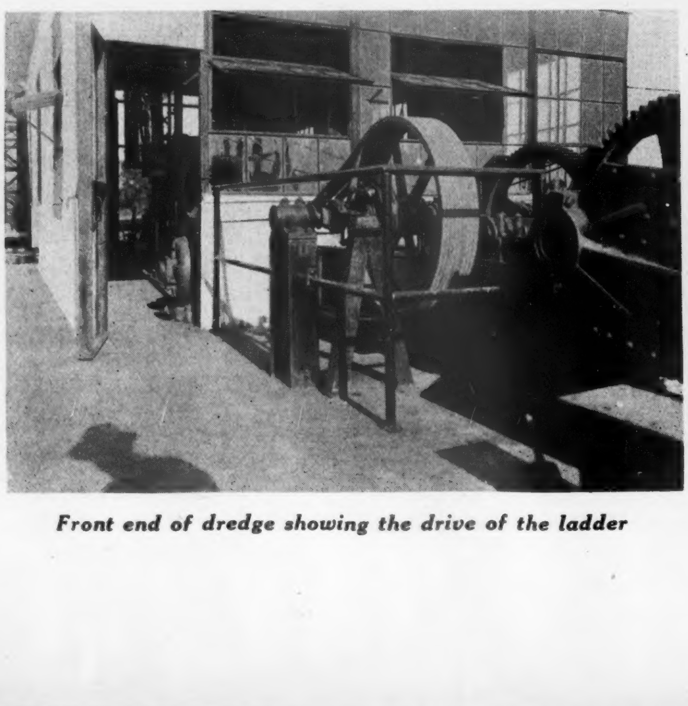
The dredge cabin is of structural steel covered with galvanized corrugated sheeting, with the entire forward end consisting of steel sash and doors. Additional steel window sash at the aft end and along the sides provide ample light, and two circular roof ventilators insure good ventilation. The cabin framing and roof trusses were designed to carry an overhead trolley beam 13 ft. above deck and located fore and aft so that all heavy parts can be readily handled to a barge moored at the stern. Ample walkways afford access to all parts of the cabin.

An unusual feature for a Swintek type of ladder dredge is the spud equipment. To facilitate accurate cleaning up of the bottom of the cut, insure a rigid hold into the bank and secure the last ton in production, the dredge is supplied with two steel stern spuds, 60 ft. long, of the latticed angle type, and equipped with cast iron points. The spuds get bearing through vertical latticed column guides which are connected by latticed beams top and bottom and are carried on the hull through trusses of sufficient length and bearing surface to properly distribute the load. Power for raising and lowering is furnished by two drums of the main hoist, the operating cables being carried above the trolley beam.

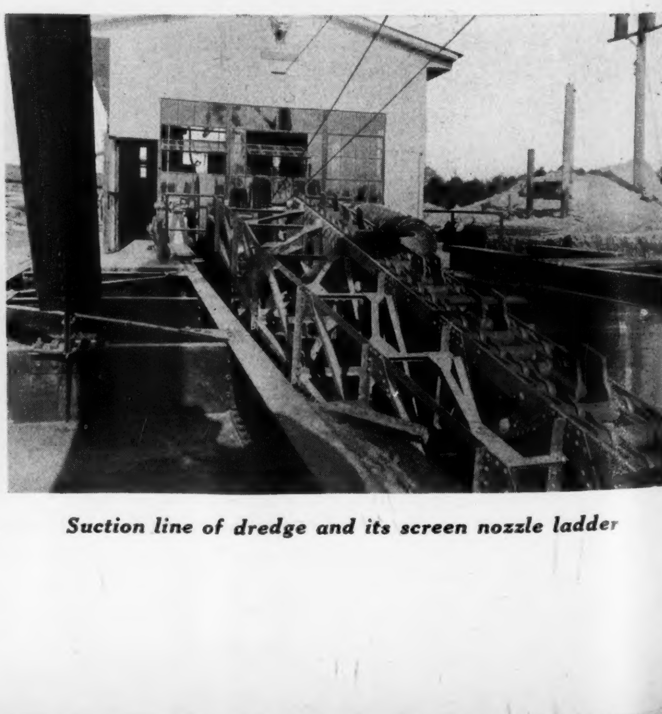
Excavated material is conveyed from the



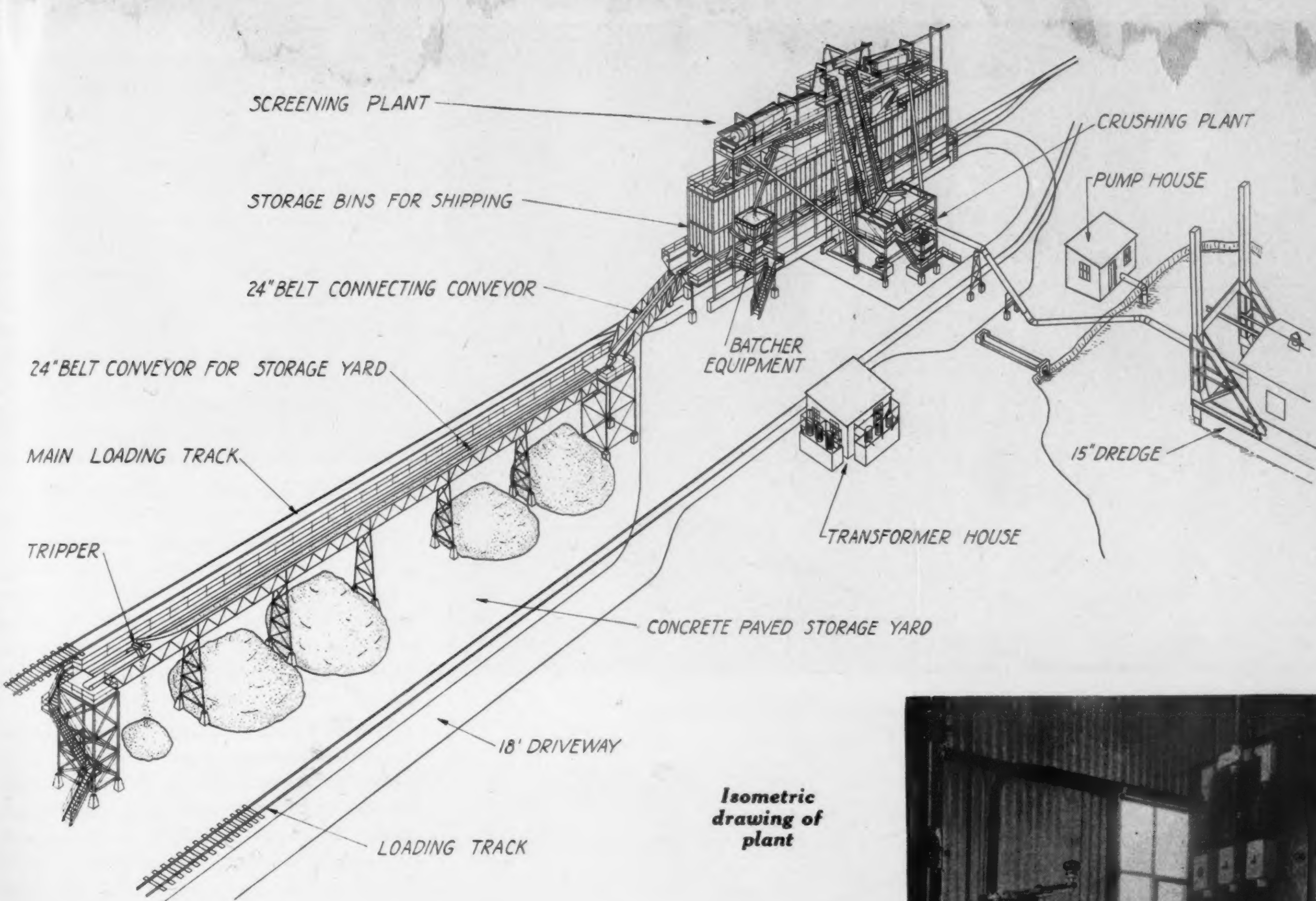
View on dredge looking toward 15-in. pump



Front end of dredge showing the drive of the ladder



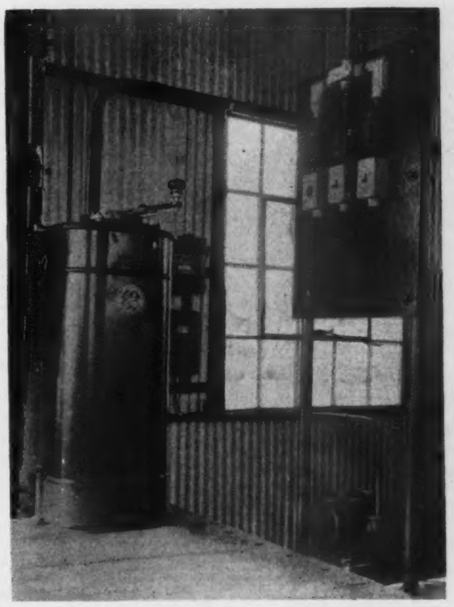
Suction line of dredge and its screen nozzle ladder



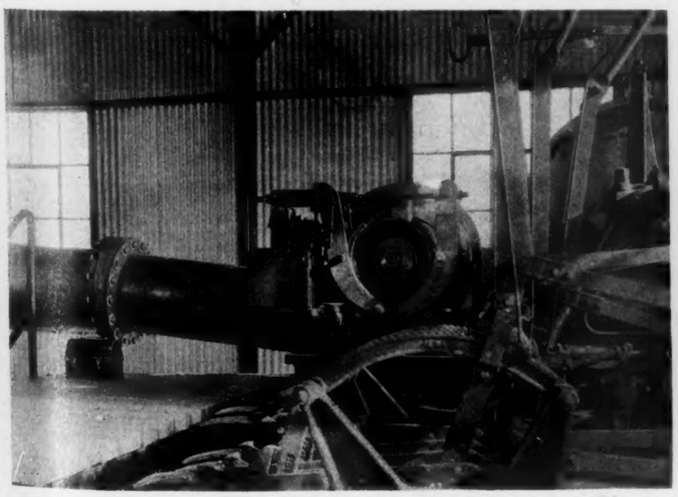
Isometric drawing of plant

ladder pipe line to the main hull through a section of flexible suction hose and then to the 15-in. Hetherington and Berner dredge pump, equipped with 18-in. suction and 16-in .discharge connections and mounted with a 3-in. wood cushion between the base and the deck. The pump is mounted on the same base with and direct-connected through a flexible coupling to a 500-hp. 4000-volt 3-phase 60-cycle slip-ring motor operating at 514 r.p.m. The motor is designed for 50% speed reduction to meet varying head conditions, with a drum type controller and continuous duty grids mounted overhead to conserve deck space. The pump shell, impeller, removable disc and throat liners are of manganese steel. The main bearing represents a considerable advance in dredge pump practice, being a complete S.K.F. anti-friction application, engineered to secure the benefits of high efficiency without sacrifice of dependability, the bearing units being complete in one large housing. Priming of the pump is done by means of an ejector operated by a high pressure water stream which exhausts the air through a connection at the top of the pump casing.

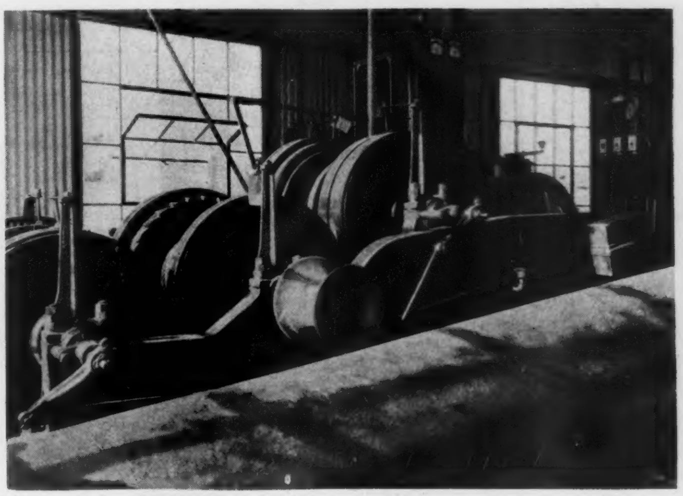
A 2-in. Fairbanks-Morse single stage cen-



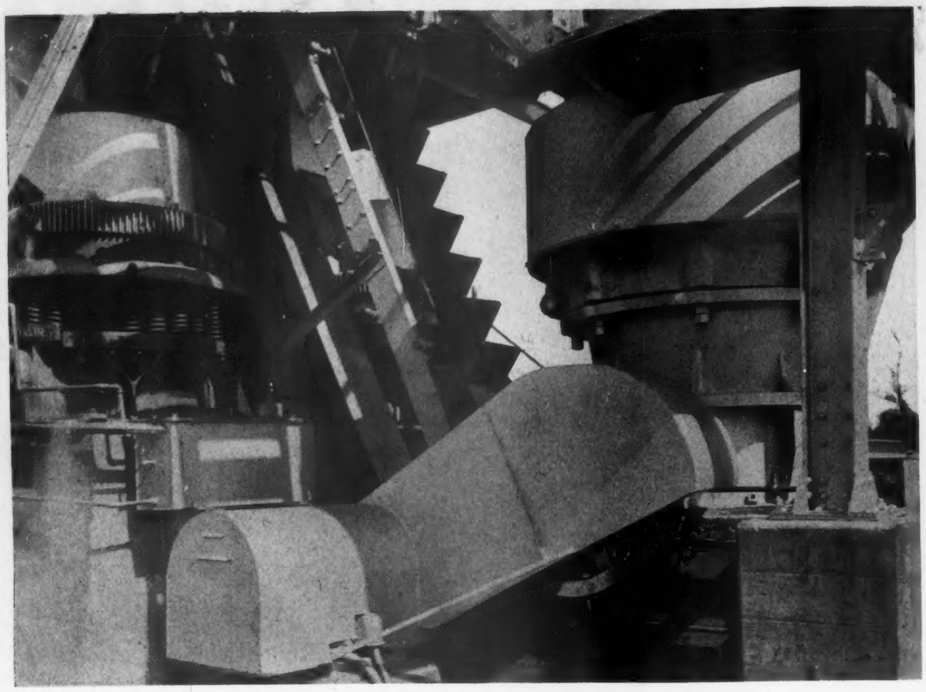
Control equipment for the 15-in. pump



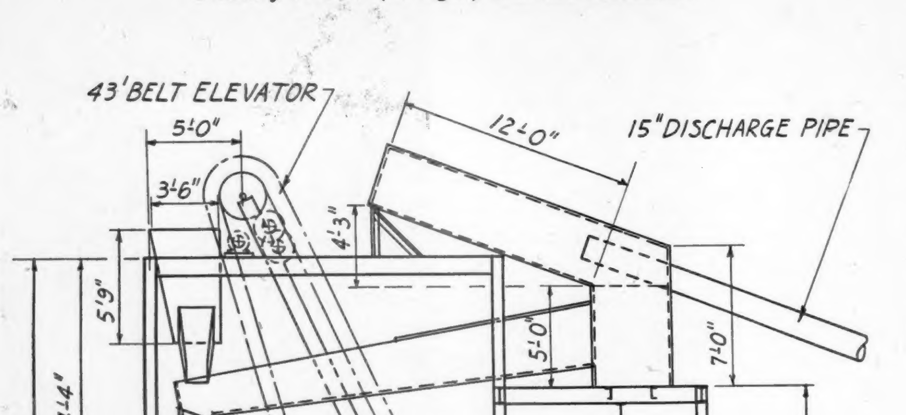
Operating levers of hoist, and, beyond, the motor with magnetic brake which drives the ladder



Special three-drum hoist with two double drums which operate ladder, shore lines and spuds



Primary crusher (at right) and two recrushers



Elevation of scalping and crushing structure

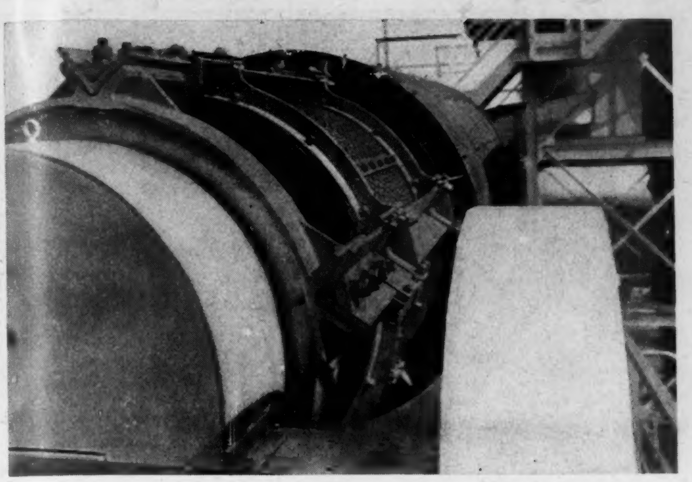
trifugal pump direct-connected to a 20-hp., 440-volt, 3400-r.p.m. motor serves for priming the dredge pump, also supplying water to the gland connection at the stuffing box and, when necessary, as a deck and bilge pump.

A special heavy duty American Hoist and Derrick Co. five-drum hoist provides power for raising and lowering the ladder, operating the two front shore lines and the two spud lines. It is driven by a 40-hp. double squirrel-cage motor through a silent chain drive and has a magnetic brake on the driven shaft. The hoist is mounted on the same heavy I-beam structure to which the ladder trunnions are attached, and a raised steel framework provides elevation for the operator's platform so that he has a clear view ahead and convenient control of the various units. Every detail has been worked out for protection against accident, including wire screen enclosures for transformers, rubber safety mats below all switches, walkways and stairs of checkered steel plate, steps over obstructions, and hand rails around machinery and along the edges of the hull.

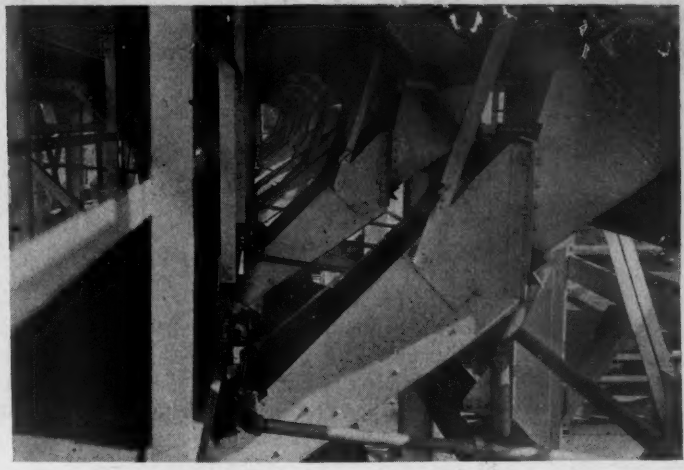
Special manganese steel pipe line fittings of Hetherington and Berner design are used. From the suction hose to the pump intake the use of straight pipe with steel wedges reduces the friction head on the suction side to a negligible item. The discharge leaves the pump through a long radius ell, inside flap valve, and then by standard 16-in. steel pipe to a pontoon line through a 10-ft. section of rubber hose at the stern. The discharge line is carried ashore on rectangular welded steel pontoons provided with both steel pipe supports and insulated cable bracket arms. The pontoons are each equipped with two vent connections permitting ventilation and easy drying out when necessary. On shore the pipe is carried to the discharge point in the scalping house on structural steel bents with a latticed truss support over the railroad and roadway.

Crushing and Scalping

The 16-in. pipe line discharges to an inclined fan-shaped box, designed to reduce the velocity of flow, and from this the material drops to a "Y"-shaped flume for delivery to the two scalping screens. A radial gate is provided to regulate the flow to each side or to one side only. The two scalping screens are Telsmith, 4x10-ft. heavy duty double deck vibrators driven by 7½-hp. totally enclosed fan-cooled motor through Texrope drives. While of the generally accepted positive eccentric throw type, these screens are unique in that each deck is equipped with a separate set of eccentric bearings exactly opposed, thus eliminating the necessity of balance wheels. The upper decks are equipped with 3-in. mesh cloth rejecting the oversize to a 13-in. Telsmith gyratory breaker. The lower decks are either 1⅛-in. or 1¾-in. mesh cloth, depending on the proportion of orders for the smaller sizes. Rejections from the lower decks drop through chutes equipped



One of the two main revolving screws above the bins



Loading chutes below bins with automatic water sprays

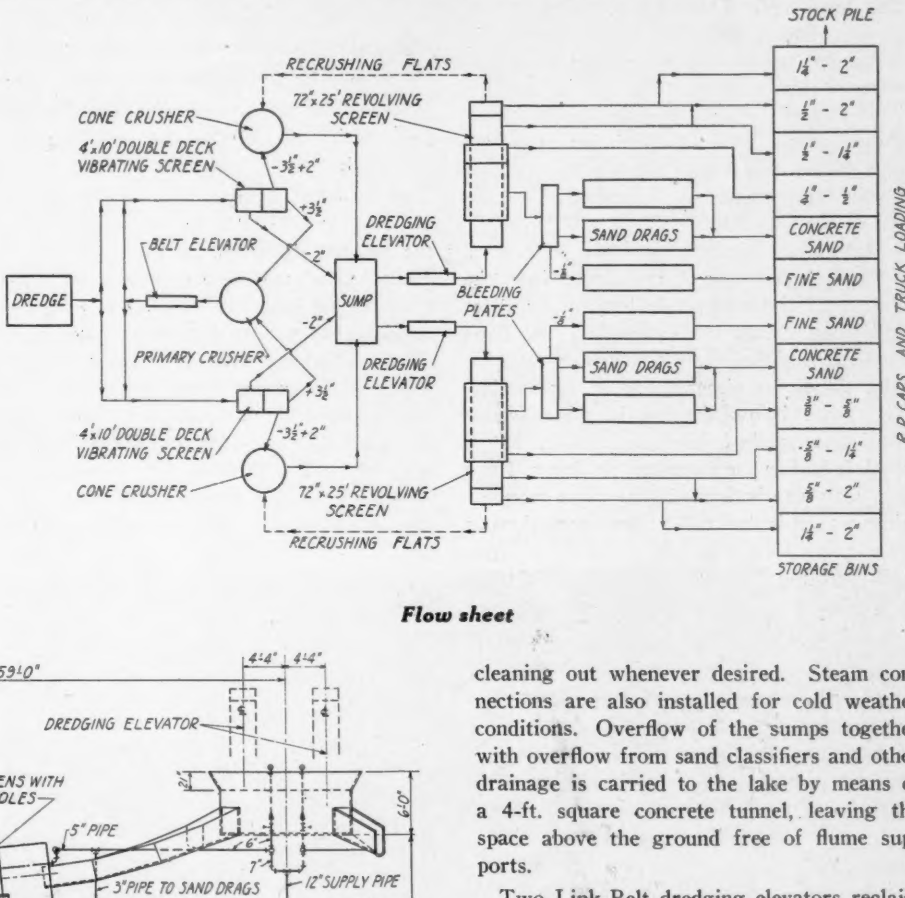
with dewatering plates to two Telsmith 36-in. cone crushers, while the sized gravel together with sand and water drops through the lower decks to the dredging elevator sumps. A 17-in. bucket elevator driven by a 10-hp. motor provides for the return of the primary breaker product to the scalping screens, while the product of the cone crushers, now largely within size requirements, discharges to the elevator sumps. The primary breaker is driven by a 50-hp. and the cone crushers by 60-hp. slip-ring motors through Texrope drives. These motors and drives, as well as all others throughout the plant, are equipped with steel plate enclosures.

The crushing and scalping equipment is located in a compact steel frame supported on reinforced concrete foundations which were poured integral with the digging elevator sumps. Stairs and walkways permit easy access to all parts of the building, and trolley beams are located for convenient handling of heavy parts.

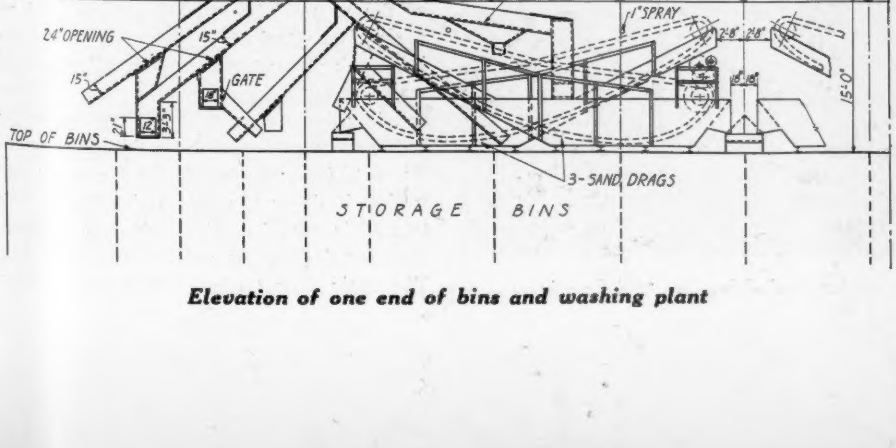
Elevators

Two reinforced concrete sumps or pits, each 41 ft. long, 6½ ft. wide and 12 ft. deep, receive the sand, gravel and water from the scalping plant. These permit the excess water to carry off foreign material in the overflow, the height of which may be regulated to control the percentage of sand going to the plant. Pipe connections are provided at the side of each sump to permit complete cleaning out whenever desired. Steam connections are also installed for cold weather conditions. Overflow of the sumps together with overflow from sand classifiers and other drainage is carried to the lake by means of a 4-ft. square concrete tunnel, leaving the space above the ground free of flume supports.

Two Link-Belt dredging elevators reclaim the material from the sumps and elevate it to the plant. These are approximately 94 ft. long, with 30x18x16-in. manganese lipped buckets carried on 17-in. pitch manganese chain and are driven by 75-hp. slip-ring motors through V-belt drives and heavy reduction gearing. Differential band brakes prevent the possibility of backward movement. Support is by means of a heavy structural steel frame designed to transmit the load to the ground independently of the bin structure. Splash pans are incorporated the entire length of the incline to return the drip from



Flow sheet



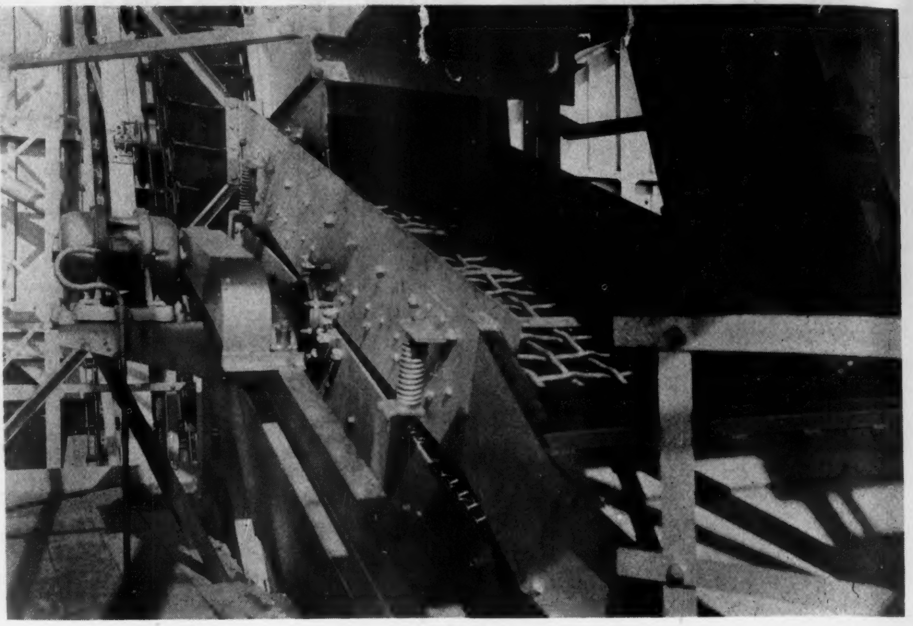
Elevation of one end of bins and washing plant

the loaded buckets, and steel plate casings enclosing the return strands catch such drip as occurs after discharge. These elevators each have a capacity of about 275 tons per hour when running at a speed of 75 ft. per min., and, due to the long travel through the sump, reclaim a full range of material.

Storage Bins

The washing, screening and classifying plant is located above an unusually large bin structure consisting of 12 units, each 12 ft. long by 21 ft. wide, with bottoms hoppered both ways to be self-cleaning. The columns are 14-in. 100-lb. "H"-beams resting on heavy girder type reinforced concrete foundations. Side plates 5/16 in. thick and bottom plates 3/8 in. thick, with channel and beam stiffeners, form the 12-bin units, each of which has a capacity of about 300 tons, all live storage. Four of the bin units are divided in halves by transverse sub-partitions to increase the number of separate sizes or gradings which may be stored. The main partitions act as girders and continuous struts absorb the horizontal stresses due to unequal loading of adjacent bin sections. The top of the bins is 48 ft. and the bottom of the hoppers 18 ft. above ground level. A batch bin consisting of a 40-ton sand bin, gravel bins and an Erie 3-way Aggremeter, is incorporated in one end of the structure.

Material is drawn from the bins to a stockpiling conveyor at the center, from the bottom of the north side hoppers by gates with long chutes for carloading, and from the bottom of the south side hoppers by gates with chutes for either truck or car loading. The space below the bin is normally for loading unbatched loads to trucks, but a track is laid in the pavement so that railroad cars may also be loaded here when complete cleaning out is desired. Steam connections in the lower part of the hoppers prevent freezing around the gates in cold weather.



One of the two double-deck vibrating scalping screens

Of particular interest to the practical operator is the provision of rinsing chutes between the gates and the loading chutes. These rinsers are very efficient and contribute in no small degree to the high quality of the product delivered, as they remove any coating which may be acquired by the gravel while in the bins. These rinsers were constructed under a patent granted to H. F. Curtis in October, 1923, and consist of a side staggered perforated slotted plate with water directed on it at three successive levels from spray nozzles operating on 40-50-lb. water pressure and controlled by special quick opening valves. A hopper under the perforated plate collects the waste water and carries it to flumes delivering into the main overflow tunnel. All gravel loading chutes are equipped with these rinsers and also with right angle hoppers at the end of the chutes to prevent segregation in carloading.

Ready access to all gates is provided by stairways made up of channel stringers with fir treads and numerous ladders. Bins as well as all other equipment received a standard red oxide shop coat with a field coat of du Pont aluminum paint.

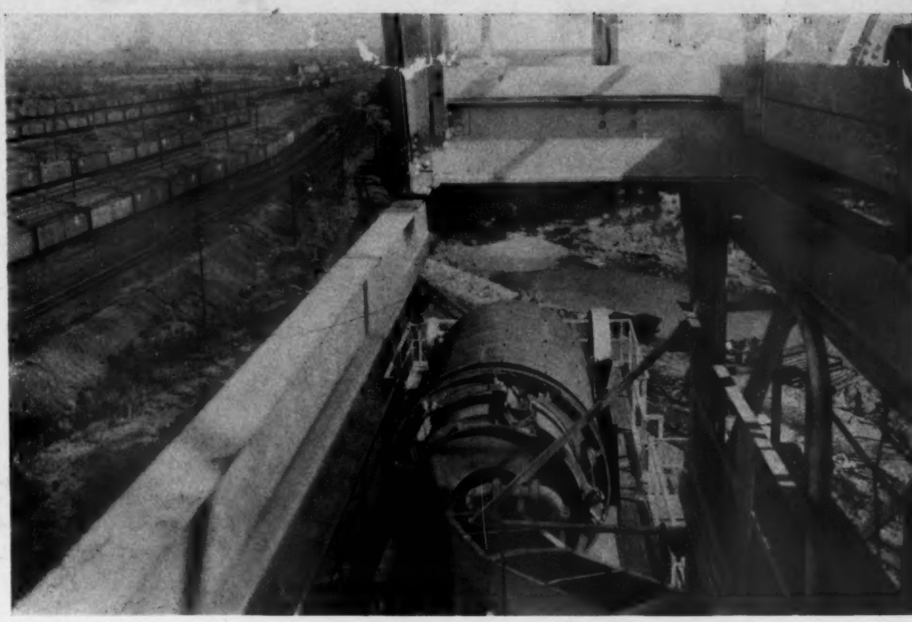
Washing and Screening

The washing and screening plant is carried above the bins on a steel superstructure. The material is received from the elevators in a steel mixing box located at an elevation of 78 ft., which is provided with an adjustable partition plate for flexibility. Two 6-in. spray pipes provide complete agitation and further soaking of the material, which then flows through rubber-lined flumes to two Telsmith Hercules 72-in. by 25-ft. combination scrubbers and washing screens. These units are Timken bearing equipped and are driven by 25-hp., 1150-r.p.m. slip-ring motors through Texrope drives. Each screen has a 5-ft. blank section where a further scouring takes place. Water, sand and small gravel is released through a perforated section 7 ft. long, served by a 5-in. spray pipe to an 11-ft. sand jacket. Water and sand passing through the jacket is flumed to 4-ft. by 8-ft. slotted bleeder plates on each side of the plant. The amount of fine sand removed is controlled by taking out or inserting blank plates together with adjustment of water spray pressure, and is generally governed by the amount it is necessary to remove to meet concrete sand specifications. The minus 1/8-in. or fine sand with the water conveying it drops through each bleeder plate to a 60-in. by 32-ft. Telsmith steel box sand drag for dewatering and delivery to the bin. The main flow travels across each bleeder

Head of elevator from recrushers with motor and drive in steel housing

plate to two similar drags located on each side of the fine sand drags which dewater and deliver concrete sand to the bins below. These sand drags were designed considerably longer than general practice in order to dewater the product as much as possible. They are driven by 7½-hp. squirrel-cage motors through reduction gearing, all completely enclosed, and are equipped with removable wearing plates and steam connections to prevent loss of time incident to draining in cold weather. The six sand drags have a total capacity of 500 tons per hour.

The gravel passing over the sand jacket on each screen is separated out through a tandem jacket 4 ft. long to a chute system and to bins as straight run with any desired proportion drawn out for mixing with minus 1¼-in. size to form graded commercial ¾-in. gravel. Two larger sizes of gravel are screened out on each side, with provision for mixing whenever desired, and the rejections, largely flats, are returned to the 36-in. cone crushers by cable-suspended return chutes. The gravel chutes are provided with heavy renewable liner plates and with clean water sprays over the perforated plates to prevent muddy water from reaching the bins. A complete monorail system with trolleys serves the screen deck, with a landing platform provided at the east end, and a similar system is installed above the platform around the elevator head frame.



Looking down on one of the two rotary washing and sizing screens

Storage System

Even under the most flexible of arrangements an excess production of certain sizes is inevitable, and to absorb this, as well as to permit adequate reserves of all sizes, a storage conveying system is provided. A 24-in. belt conveyor 143 ft. long runs through below the bins and receives material from any compartment through a set of 16 Telsmith Boquad bin gates. This conveyor discharges to a 112-ft. connecting conveyor which in turn discharges to a 24-in. stockpile conveyor 360 ft. long located approximately 35 ft. above ground level. The ground space below the storage conveyor is paved with concrete and divided into six bays with railroad loading tracks 130 ft. apart on each side. In this way cars are loaded by a crawler crane from either side of the stockpiles. Distribution of the material from the long belt conveyor is accomplished by means of a two-spout automatic tripper. An unusual feature for storage systems of this type is the provision of the Curtis washing chutes for rinsing the gravel before dropping it into the piles below, with a drainage system to convey the dust and grits carried off with the water.

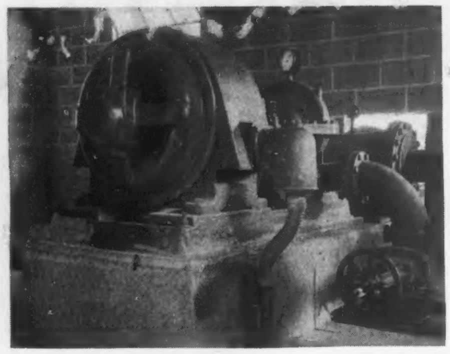
General view of crushing and scalping structure

The conveyor supports are of structural steel and the conveyors consist of Medart pulleys, Stearns roller bearing idlers, Goodyear Style "W" belting and are driven by individual motors through Jones speed reducers. Gravity takeups are used on the storage and connecting conveyors. Belt scrapers are provided for cleaning at the end of each conveyor and in addition a rotary brush is used at the end of the stockpile conveyor.

A storage capacity of approximately 30,000 tons is provided by the present conveyor which can be easily extended for additional capacity.

Water Supply

A plentiful supply of clean wash water so necessary in gravel plant operation is obtained from a portion of the lake which is separated by a sheet piling bulkhead from



One of the pumps supplying wash water

the main part in which the dredge now operates. A 26 ft. by 17½ ft. concrete block pump house is located near the bank with its footings protected by a sheet piling retaining wall. Water is drawn in through a 16-in. suction pipe equipped with a foot valve and strainer to a 16-in. tee from which 8-in. suction connections are carried to the pumps. These consist at present of two Worthington single stage centrifugal units direct-connected to a 100 hp. 1750 r.p.m. squirrel cage motors and deliver about 2000 g.p.m. each against a total head of 155 ft. They operate at 83% efficiency and are primed by means of a Quimby 1¼-in. centrifugal pump equipped with an Apco automatic primer. Provisions were made for the installation of a third pump later. The discharge of each pump connects to a 12-in. header in a trench below the pump house floor and which runs underground to the bin foundations, a distance of about 230 ft. This line is pitched upward toward the plant and at the low point at the pump house is provided with an extended spindle controlled valve so that the system can be drained in cold weather. The 12-in. line is carried by special hangers up the side of the bin to the top of the plant, where two 6-in. lines are taken off to supply the spray pipes on each side of the mixing box. Additional 6-in. branches run to the screen spray pipes from which 2½-in. laterals are carried to the bleeder plates, chute sprays and sand drag sprays. At the bottom of the bins two 3-in. headers are taken off, which run to both ends of the bins and out on the storage conveyor to supply sprays on the Curtis washing chutes. A complete drainage system collects all waste water from the sand drags and delivers it to a waste water tunnel by means of a 20-in. down spout, while the discharge from the rinsing chutes is carried to the same point by flumes. An auxiliary system permits draining water out of the six sand drags whenever desired. An additional independent drainage system collects the dirty water from the washers at the storage conveyor and delivers it to the lake along with ground drainage by means of a 24-in. concrete pipe laid underground.

Power Supply

Power is supplied at 13,200 volts by the Philadelphia Electric Co. The high tension current is reduced to 4000 volts by three 333 KVA primary transformers from which it is carried inside the substation to the metering equipment. The 4000 volt supply is controlled by means of oil switches mounted on three separate panels. The dredge is supplied at 4000 volts by submarine cable, while the plant supply is reduced to 440 volts by three 250 KVA secondary transformers. The 440 volt secondary leads are returned inside the station to three distribution panels each equipped with an oil switch for supplying the main plant and conveyors, the water pumps, and the crushing and scalping building. Three additional panels each carry automatic starters for the crusher motors. Starters for the scalping screens and return elevator motors are wall mounted, with push button control stations at the crusher house. Starters for the digging elevators, rotary screens and sand drags are located on panels in a control house on the screen floor with a view of the entire operation and push button stations are also located near the individual machines. Starters for the stockpiling conveyor motors are located at the west end of bins and starters for the clean water pumps are wall mounted in the pump house.

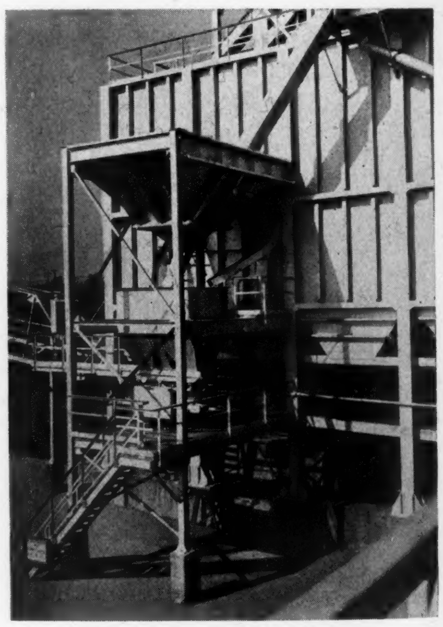
Power for the dredge at 4000 volts is carried by a Roebling three conductor armored submarine cable mounted on the pontoons. The 500 hp. dredge pump motor is wired direct from the 4000-volt supply, while the auxiliary dredge motors are operated at 440 volts taken from the low side of three 37½ KVA 4000/400-volt transformers. The lighting circuit is supplied by a single phase lighting transformer.

For night operation the lighting system includes six 500-watt floodlights located at strategic points and some 30 outlets for reflector units distributed throughout the plant. The dredge is equipped with a 500-watt floodlight forward and aft and three 200-watt reflector units inside the cabin.

All of the motors are General Electric as well as most of the other electrical equipment. The electrical installation was made by the Franklin Electric and Construction Co. of Pittsburgh, Penn.

Organization

The general offices of the company are in the new Broad Street Station building in Philadelphia. H. F. Curtis, a former operator and railroad contractor, is president and treasurer; H. L. Curtis is secretary; and T. P. McCue is sales manager. The company was organized in 1918 and for several years operated a plant in the Morrisville area which was leased in 1925 to the Van Sciver Corp. and later absorbed by the Warner Co. in 1929. Construction of the new plant and the re-establishing of the company in gravel production was personally supervised by H. F. Curtis. The dredge was designed and erected by Hetherington and Berner, Inc., Indianapolis, Ind., and the plant was designed and built by the Pittsburgh Engineering, Foundry and Construction Co. in collaboration with the Smith Engineering Works of Milwaukee, who furnished most of the machinery, with the writer as resident engineer. Belmont Iron Works of Philadelphia fabricated and erected most of the structural steel.



Batching bin for truck loading

EQUIPMENT TABLE OF CURTIS AND HILL PLANT

Unit	Size or type	Manufacturer	Motor size	Drive
Dredge ladder	50-ft. Swintek, 18-in. suction	Eagle Iron Works	40-hp. squirrel-cage	Texrope and gears
Dredge pump	15-in. manganese, roller bearing	Hetherington and Berner	500-hp. slip-ring	Direct-connected
Dredge hoist	5-drum	American Hoist and Derrick Co.	40-hp. squirrel-cage	Silent chain
Priming pump	2-in. centrifugal	Fairbanks-Morse Co.	20-hp. squirrel-cage	Direct-connected
Primary crusher	13-in. steel gyratory	Smith Engineering Works	50-hp. slip-ring	Texrope
Secondary crushers (2)	36-in. cone	Smith Engineering Works	60-hp. slip-ring	Texrope
Return elevator	17-in. buckets, 43-ft. centers	Smith Engineering Works	10-hp. squirrel-cage	Texrope
Scalping screens (2)	4x10-ft. 2-deck vibrators	Smith Engineering Works	7½-hp. squirrel-cage	Texrope
Main elevators (2)	30-in. buckets, 94-ft. centers	Link-Belt Co.	75-hp. slip-ring	Texrope
Sizing screens (2)	72-in. by 25-ft. rotary	Smith Engineering Works	25-hp. slip-ring	Texrope
Sand classifiers (6)	60-in. by 32-ft. drag flight	Smith Engineering Works	7½-hp. squirrel-cage	Gear reducer
Bin conveyor	24-in. by 143-ft. horizontal	Stearns idlers	7½-hp. slip-ring	Jones reducer
Connecting conveyor	24-in. by 114-ft. inclined	Goodyear belts	15-hp. slip-ring	Jones reducer
Stock-piling conveyor	24-in. by 372-ft. horizontal	Medart pulleys	20-hp. slip-ring	Jones reducer
Loading crane	1¼-yd. crawler, gasoline type	Link-Belt Co.		
Water pumps (2)	6-in. centrifugal	Worthington	100-hp. squirrel-cage	Direct-connected
Priming pump	1-in. centrifugal	Quimby	1½-hp. squirrel-cage	Direct-connected

Grinding Plant Research*

Part II—Tests of Cement Clinker Grinding Mills

By William Gilbert
Wh.Sc., M. Inst. C. E., London, England

IT IS NEXT PROPOSED to describe two representative tests in detail. The tests were made at an early stage of the grinding plant research, but they bring out useful information. A test of a modern fine grinding compound tube mill will be described later.

In making the tests on grinding mills for coal and cement clinker it soon became apparent that the results obtained were not comparable, since the mills operated under variable conditions of diameter, speed, hardness of clinker, fineness of grinding, size and type of grinding bodies and quantity of material mixed with the charge. In some cases the power used could only be approximately measured and the mill could not always be stopped, after a test, for the purpose of weighing out the charge of grinding bodies and the quantity of material retained in the mill. Hence, it was concluded that a considerable part of the desired information could best be obtained from an experimental tube mill installed in a suitable laboratory. These tests and the results will be given later.

Editor's Note

THE first article of this series (Rock Products, November 21, 1931) dealt with the general principles and fundamentals of tube mill grinding.

In the present article some of the tests made on cement clinker grinding mills are described in detail.—The Editors.

Test of Clinker Grinding Mills at I. C. Johnson's Works, Greenhithe, Kent

Referring to Figs. 6 to 9, a preliminary tube mill (a) is placed vertically over a finishing tube mill (b). A cross-section of each mill is shown at Figs. 7 and 9. Each mill consists of a single compartment, which is carried at each end on a large journal bearing. The material enters and leaves each mill through the journals.

Data on Preliminary Mill

The dimensions inside the lining plates are shown in Figs. 6 and 7.

The lining consisted of smooth steel plates, with six longitudinal lifter bars, 2 9/16-in. by 1½-in., in cross section bolted on, as indicated in Fig. 7.

The grinding bodies were steel balls with a total weight of 290 cwt†., mostly 4 in. in diameter, but with a few balls of 3- and 2-in. diameter.

Depth of charge below center line, 6-in.

Material from compartment, 84.8 cwt.† weighing 96 lb. per cu. ft.

The material left the mill through a 16⅝-in. hole bored through the journal marked *B* in Fig. 6. The hole was covered by a grid shown in Fig. 10, which had clear openings aggregating 72 sq. in. The grid (marked *E* on Fig. 6) was set back 7½ in. from the line *UV* of the end plate.

The mill was fed through the journal *A* by a percussion feeder. There were no screens.

Mill volume inside lining, 422 cu. ft.

Charge volume (by graph Fig. 2, Part I), 39.2%.

Value of *Rg* (Figs. 1 and 2, Part I), 18.5 in.

Charge volume, 165.4 cu. ft.

Weight of grinding bodies per cu. ft. of charge volume, 196.5 lb.

Ratio of material volume to void volume, 202.0%.

Speed factor, *Sf*, 189.

Average speed, 23.1 r.p.m.

Horsepower as measured, 149.

Horsepower factor, *Pm*, 1073.

Horsepower factor, *Po*, 812.

Data on Finishing Mill

The dimensions inside lining plates were as shown in Figs. 8 and 9.

The mill lining consisted of smooth steel plates.

The grinding bodies were flint stones with a total weight of 244 cwt.† in sizes from 1¼ oz. to 9 oz.

Depth of charge surface below center line, 2½ in.

Material from compartment, 89 cwt.† weighing 95 lb. per cu. ft.

The mill discharged through a grid similar to that used on the preliminary mill.

Volume inside lining, 636 cu. ft.

Charge volume from graph, 45.4%.

†112 lb. based on English ton of 2240 lb.

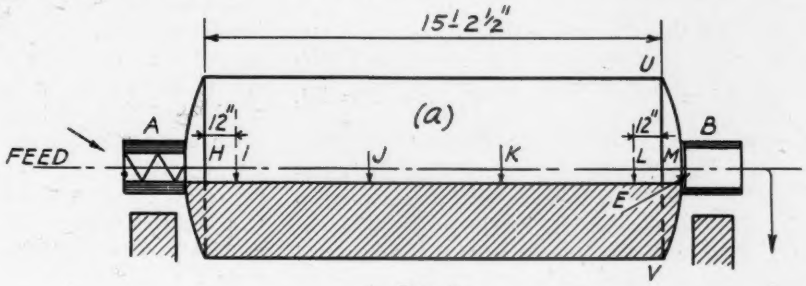


FIG. 6

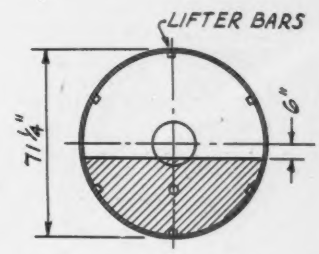


FIG. 7

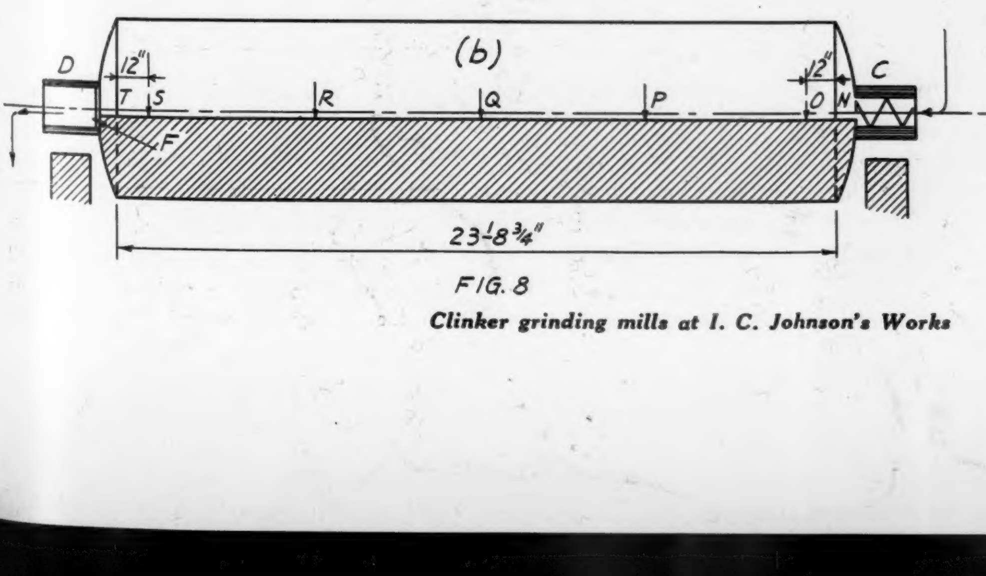


FIG. 8

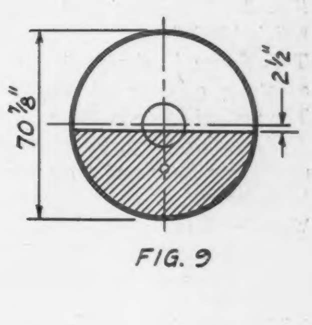


FIG. 9

Clinker grinding mills at I. C. Johnson's Works

Value of Rg from graph, 16.3 in.
Charge volume, 288.7 cu. ft.
Weight of grinding bodies per cu. ft. of charge volume, 94.6 lb.
Ratio of material volume to void volume, 86.0%.
Speed factor, Sf, 181.
Average speed, 21.9 r.p.m.
Horsepower as measured, 111.
Horsepower factor, Pm, 1073.
Horsepower factor, Po, 812.

Test Details

The material which was ground was wet process rotary clinker. It passed direct from the coolers to a large storage hopper placed over the preliminary mill.

The cement ground during the test was delivered into a bin, formed on the flat floor of a warehouse. It was subsequently bagged and weighed.

The two mills were driven by ropes from one 300-hp. direct-current motor. Since the ropes could not conveniently be removed the no-load losses of the motor were not measured. The electrical input was 980 amperes at 220 volts, or 289 electrical hp. The motor efficiency at this load, as taken from a curve supplied by the makers, was 90%. Hence, horsepower = 0.9 × 289 = 260.

Samples of the material leaving each mill were taken half-hourly for sieve tests. The duration of test was eight hours.

The quantity ground per hour, reckoned dry, was 6.66 tons.

SIEVE TESTS

	Remaining on sieves On 180-mesh	On 76-mesh	On 50-mesh
Leaving preliminary mill	35.0%	17.0%	9.0%
Leaving finishing mill	13.0%	1.3%	....

Horsepower per ton ground per hour, 39.0.

Horsepower per ton referred to 15% on 180 mesh, 37.1.

At the end of the test the mills were stopped on full feed, and the manhole covers removed. After the interiors had cooled down, samples were taken, at regular intervals longitudinally, and sieve tests made. The result is shown on the graph, Fig. 11, which will be explained later.

Working Out the Test

Preliminary Mill. The ratio $\frac{a}{d}$, Fig. 1, is:

$$\frac{6 \times 100}{71.25} = 8.42\%$$

hence the charge volume per cent. and the value of Rg can be taken from the graph, Fig. 2. The grinding bodies (steel balls) weigh 196.5 lb. per cu. ft. of charge volume. This figure is abnormal and is due to the excessive quantity of material in the mill. The normal value is 282, as shown in Part I.

The voids were not measured, their volume being estimated from formula F(2) in Part I thus:

Volume of voids =

$$\frac{w}{663} = \frac{290 \times 112}{663} = 49.0 \text{ cu. ft.}$$

The material volume was 99.0 cu. ft., hence the ratio of the material volume to the void volume was $\frac{99 \times 100}{49} = 202\%$.

Speed Factor. From F(7), Part I, $Sf = N\sqrt{D-d}$. Taking the ball diameter at 4 in., we have $Sf = 23.1 \sqrt{71.2 - 4} = 189$.

Finishing Mill. The details are worked out generally as just explained. The volume of the voids in the grinding bodies (flints) as estimated by F(6) in Part I was:

$$\frac{W}{224} = \frac{244 \times 112}{224} = 122 \text{ cu. ft.}$$

$$\text{Preliminary mill} = \frac{149}{6.66} = 22.4 \text{ hp.} = AF \text{ on graph.}$$

$$\text{Finishing mill} = \frac{111}{6.66} = 16.6 \text{ hp.} = FL \text{ on graph.}$$

$$\text{Total} = 39.0 \text{ hp.}$$

The material volume from the data given was 105 cu. ft. Hence the ratio of the material volume to the void volume was:

$$\frac{105}{122} \times 100 = 86\%.$$

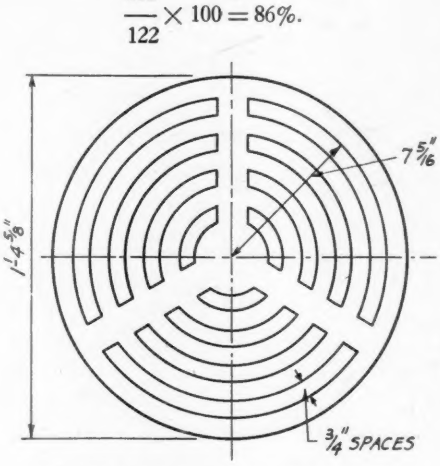


Fig. 10. Discharge grids of mills

Taking the diameter of the average flint stone at 2 in., we have for the speed factor:

$$Sf = N\sqrt{D-d} = 21.9\sqrt{70.1 - 2} = 181.$$

Horsepower Factors

Together the mills take 260 hp. It is possible to divide this amount between the two by F(8)A in Part I. The weight of material in the preliminary mill is abnormal, and the calculation is made by the formula which takes the material weight into account. From the data given we have:

$$\text{Hp.} = \underset{\text{(Preliminary mill)}}{\frac{374.8 \times 23.1 \times 18.5}{Pm}} + \underset{\text{(Finishing mill)}}{\frac{333 \times 21.9 \times 16.3}{Pm}} = 260.$$

$$\text{Hence } Pm = \frac{374.8 \times 23.1 \times 18.5}{260} + \frac{333 \times 21.9 \times 16.3}{260}$$

$$\text{and } Pm = 616 + 457 = 1073.$$

Substituting this value of Pm in the expression for hp. above, we obtain:

Preliminary mill = 149 hp.
Finishing mill = 111 hp.
Total = 260 hp.

If the calculation is made omitting the weight of the material, the value of Po is found to be 812.

Axial Sieve Test

The positions at which samples were taken for the axial sieve test is shown in Figs. 6 and 8. A sample was taken 12 in. from each end plate of each mill, and the intermediate space in each case was divided into a number of equal parts IJ, JK and OP, PQ, etc.

Fig. 11 is a graph showing the result. The base line AL represents hp. per ton ground per hour. In this case the figures from the above data are:

The lengths AB, BC, CD bear the same ratio to one another on the graph as the measured lengths HI, IJ, JK do in Fig. 6.

The vertical line AM on the graph is divided into sieve residues per cent. The ordinate CQ, for instance, corresponds to position J in Fig. 6, and the residues on 180-, 76- and 50-mesh, as obtained from the sieve tests of the sample taken at this point, are plotted down on CQ. The complete curves are thus obtained.

Referring to the curve showing the residue on 180 mesh, it will be seen that the clinker disintegrated to a considerable extent as soon as it entered the preliminary mill, since the feed residue on 180 mesh was 100%. Apparently the 4-in. diameter balls did very little grinding. This poor result may have been partly due to the abnormal quantity of material in the mill. When the material entered the finishing mill the 6 oz. flints ground it with reasonable efficiency.

The disintegration of the clinker on entering the preliminary mill (to a greater or less extent) is a common occurrence, and may be due to internal strains in the lumps which are induced by rapid heating or cooling.

On the graph, a curve MNO is drawn, starting at 100% residue on 180 mesh, which represents the state of the material as it enters the preliminary mill, and terminating at 13% residue on 180 mesh, which represents the state of the material as it leaves the finishing mill. The curve MNO is a standard. Given the terminal points, it shows what the residue on 180 mesh should be in any intermediate position, in relation to the horsepower expended, provided the

material is uniformly hard to grind throughout the range.

FN shows what the residue on 180 mesh should be (in relation to the power expended) as the material leaves the preliminary mill. It is concluded (as previously stated) that the material easily disintegrated until the residue on 180 mesh was about 45%, afterwards it became reasonably hard to grind.

The method of obtaining the standard curve MNO will be described later; it is based on the grinding of standard sand.

General Conclusions and Notes on Test

Preliminary Mill. Comment is made on the high ratio of the material volume to the void volume, which was 202%. It will be seen later that, if this ratio exceeds 100%, the grinding efficiency begins to fall off.

The charge volume, calculated on the grinding bodies *only*, was 27.2%, and the corresponding distance a in Fig. 1, as taken from the graph in Fig. 2, would be 13.1 in. The mill discharged by a central opening, covered by a grid, the radius to the outside of the outer slot, Fig. 10, being 7 5/16 in., hence the charge in the mill would have to open out considerably (with a normal quantity of material present) before a satisfactory discharge could take place.

The speed factor was 189. Referring to the curves shown in Fig. 4, Part I, which illustrate the effect of the speed factor on cascading, it will be seen (by interpolation) that the charge would not be likely to open out much, hence it is probable that a considerable excess of material had to accumulate in the mill before a satisfactory discharge could take place.

The average size of the balls used, i.e., 4 in. in diameter, in so long a compartment, was altogether unnecessary, but this was not fully recognized at the time.

Finishing Mill. A similar discharge grid was in use. The flints, when at rest, without material, would come to within 2½ in. of the mill center line, since the voids were not filled. The cascaded charge probably covered the grid, and the quantity of material retained in the mill, i.e., 86% of the void volume, was satisfactory.

The average size of the flints used, which was 2 in. in diameter, or 6.4 oz., was far too large.

The horsepower factor, with the material included, $Pm = 1073$, is much higher than the average, which may be taken at 800. The mills apparently took less power than they should have done, but the quantity of material in the preliminary mill was abnormal.

*112 lb., based on English tons of 2240 lb.

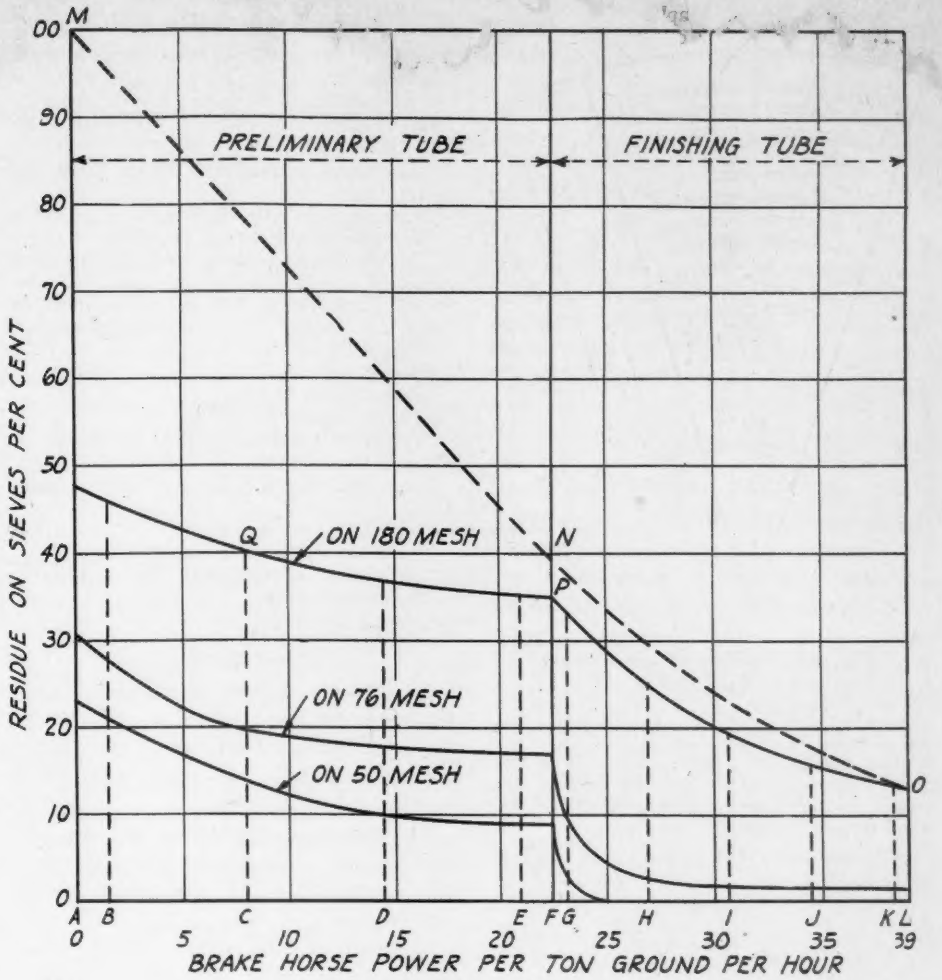


Fig. 11. Graph of grinding in I. C. Johnson mills

Test of Clinker Grinding Mills, Cameron Swan's Works, Newcastle-on-Tyne

Referring to Figs. 12 and 13, the clinker grinding plant consisted of a preliminary tube mill and a finishing tube mill.

The preliminary mill was fed through the journal of the bearing at A, and was divided into two compartments by a diaphragm plate BC. The first compartment was charged with steel balls and the second with flint stones. The mill dicharged through periphery ports, but there was a second diaphragm plate at DE, which was put in to prevent choking of the ports by broken pieces of flint.

The cement grit leaving the preliminary mill was elevated and entered the finishing mill through the journal of the bearing at F. The mill was loaded with flint stones. The discharge was through periphery ports, which were protected by a diaphragm plate GH.

Data on Preliminary Mill, Compartment (a)

The dimensions inside the lining plates (for all compartments) are marked on Figs. 12 and 13.

The lining was of smooth steel plates, in good condition.

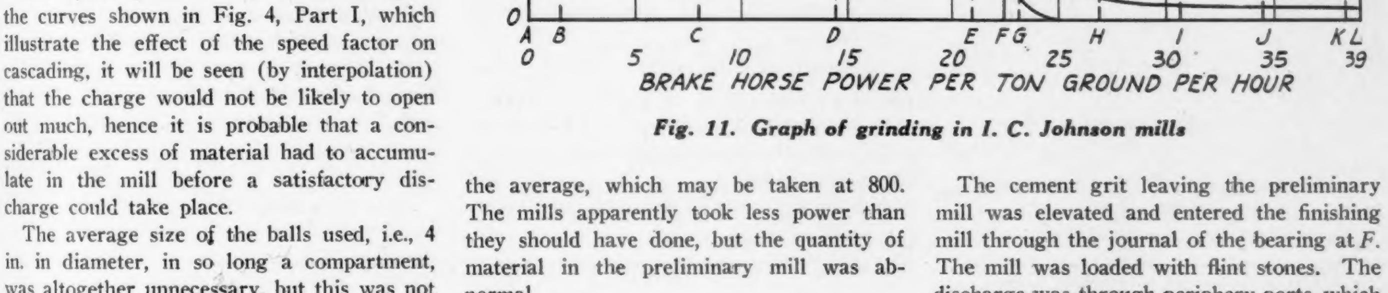
The grinding bodies were steel balls of a total weight of 148 cwt.* in sizes 2 in. to 3⅞ in. diam.

The charge surface was 16.7 in. below the center line.

Material from compartment (a), 22.4 cwt.*

Material weight per cu. ft., 90 lb.

The diaphragm plate, marked BC on Fig.



Clinker grinding mills at Cameron Swan's Works

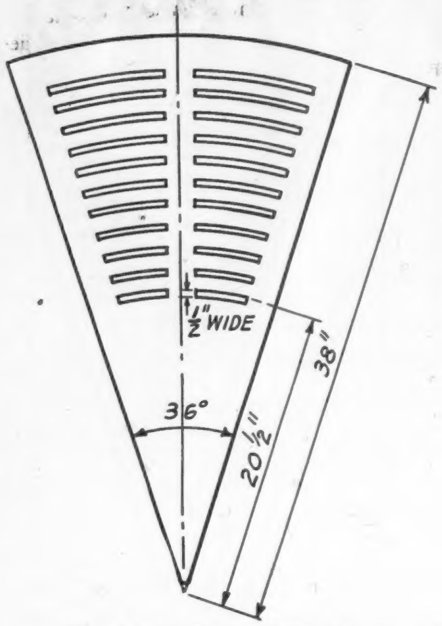


Fig. 14. Section of diaphragm plate "BC" in Fig. 12

13, was in 10 sections, as in Fig. 14. Each section had 22 slots, ½ in. wide. The total area (for 10 plates) was 750 sq. in. The radius to the inner slot was 20½ in. The slots were all clear.

A percussion feeder was used, and no screens.

Volume of compartment inside lining, 272 cu. ft.

Charge volume, 22.7%.

Value of Rg, 25.3 in.

Charge volume, 61.7 cu. ft.

Weight of steel balls per cu. ft. of charge volume, 271 lb.

Ratio of material volume to void volume, 112%.

Hp. for compartment, 137.

Data on Preliminary Mill, Compartment (b)

The lining plates were of smooth steel.

The grinding bodies were flint stones of a total weight of 72 cwt.* in sizes from 3 oz. to 10 oz.

The charge surface was 8.86 in. below the center line.

Material taken from compartment (*b*), 15 cwt.*

Material weight per cu. ft., 90 lb.

The diaphragm plate *DE*, Fig. 12, was similar to *BC* with periphery ports of ample area.

Volume of compartment inside lining, 233 cu. ft.

Charge volume, 35.4%.

Value of Rg, 21.0 in.

Charge volume, 82.4 cu. ft.

Weight of flints per cu. ft. of charge volume, 98 lb.

Ratio of material volume to void volume, 52.0%.

Hp. for compartment, 57.0.

Average speed, 22.6 r.p.m.

Speed factor Sf—

Compartment (*a*), 192.

Compartment (*b*), 194.

Horsepower as measured, 194.

Horsepower factor, Pm, 715.

Horsepower factor, Po, 612.

*112 lb., based on English tons of 2240 lb.

Data on Finishing Mill

The mill lining was of silex blocks in good condition.

The grinding bodies were flint stones of a total weight of 156 cwt.* in size from 3 oz. to 10 oz.

The charge surface was 6.4 in. below the center line.

Material from mill, 28.2 cwt.*

Material weight per cu. ft., 90 lb.

The diaphragm plate at *GH*, Fig. 13, contained 30 curved slots, average size 7¼ in. by ½ in. Total area, 108 sq. in. Radius to inner slot, 18 in. The slots were clear.

Volume of mill, inside lining, 473 cu. ft.

Charge volume, 37.6%.

Value of Rg, 17.6 in.

Charge volume, 178 cu. ft.

Weight of grinding bodies per cu. ft. of charge volume, 98 lb.

Ratio of material volume to void volume, 45.0%.

Average speed, 22.0 r.p.m.

Speed factor, Sf, 176.

Horsepower as measured, 102.

Horsepower factor, Pm, 700.

Horsepower factor, Po, 593.

Test Details

The material ground was rotary clinker made from the lime waste of an alkali works and clay. It was hard burned and proved difficult to grind. The large lumps were screened out and crushed.

The cement ground during the test was delivered into a bin, formed on the flat floor of a warehouse. It was subsequently bagged and weighed.

Each mill was driven by a 200-hp. alternating current motor. For the preliminary mill the test figures were: 242.4 amperes, 421.2 volts, 0.875 power factor, 0.93 motor efficiency, 194 hp.

For the finishing mill the test figures were: 149.4 amperes, 425 volts, 0.795 power factor, 0.92 motor efficiency, 108 horsepower; 6 hp. was deducted for an elevator and conveyors, leaving 102 hp. for the mill.

Half hourly samples were taken of the material entering the preliminary mill, and of the material leaving each mill.

The duration of the test was 8 hr. and the quantity ground per hour was 5.85 tons.

Horsepower per ton ground per hour—

As ground, 50.5.

Referred to 15% on 180 mesh, 51.8.

SIEVE TESTS

(Per cent. of material remaining on sieve sizes)

Sieve size	Entering preliminary mill	Leaving preliminary mill	Leaving finishing mill
½-in.	11.0%	....	....
¼-in.	39.0%	....	....
50-mesh	....	2.0%	....
76-mesh	....	7.0%	0.4%
180-mesh	....	35.0%	16.0%

Working Out the Test

Taking, for example, the preliminary mill, compartment (a), the ratio $\frac{a}{d}$ in Fig. 1, Part I $= \frac{16.7}{75.2} \times 100 = 22.2\%$. Hence from the graph, Fig. 2, the charge volume is 22.7%, and the ratio $\frac{Rg}{d}$ is 33.6%.

The compartment volume is calculated from the dimensions given in Fig. 12 as 272 cu. ft., hence the charge volume is $\frac{22.7}{100} \times 272 = 61.7$ cu. ft.

The value of Rg is $\frac{33.6}{100} \times 75.2 = 25.3$ in.

Since the compartment diameter is 75.2

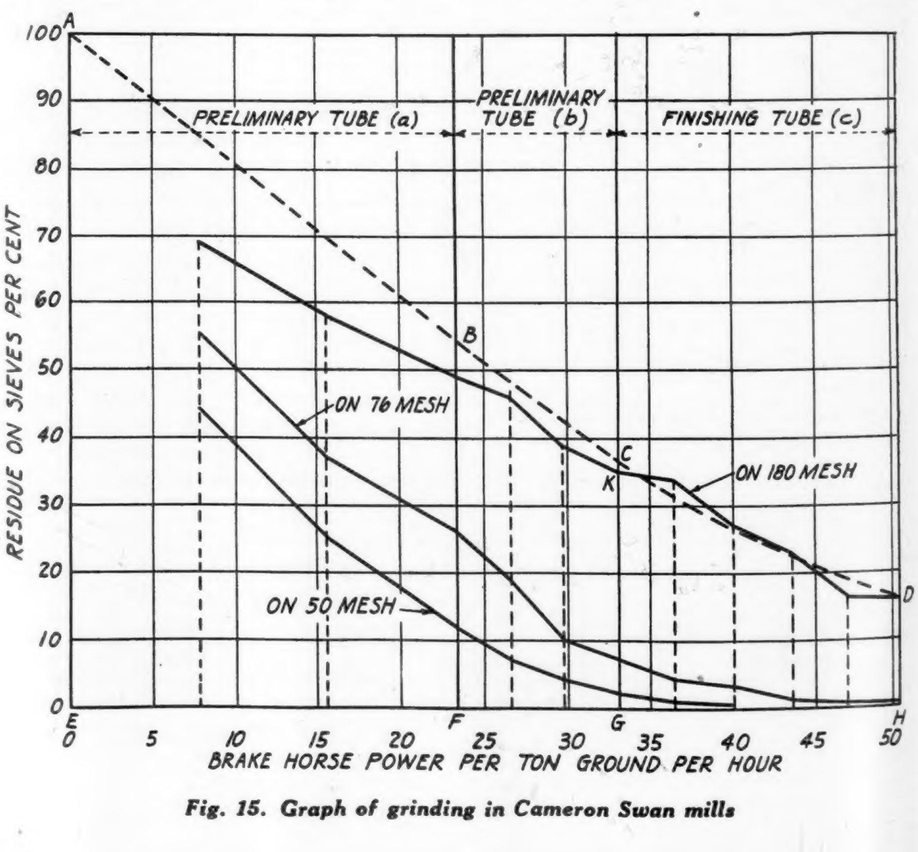


Fig. 15. Graph of grinding in Cameron Swan mills

in., the average ball diameter 3 in., and the speed, 22.6 r.p.m., the value of the speed factor is:

$$Sf = 22.6 \sqrt{75.2 - 3} = 192.$$

The horsepower required to drive the preliminary mill is worked out as follows:

$$\text{HP.} = \frac{242.4 \times 421.2 \times 0.875 \times \sqrt{3} \times 0.93}{746} = 194.$$

To subdivide the power between the two compartments, (a) and (b) the formula F (8) A is used, the material weight being included—

$$194 = \overset{(a)}{\frac{170.4 \times 22.6 \times 25.3}{Pm}} + \overset{(b)}{\frac{87 \times 22.6 \times 21.0}{Pm}}$$

Solving the equation, the value of Pm is found to be 715, hence the power required for compartment (a) is—

$$\frac{170.4 \times 22.6 \times 25.3}{715} = 137 \text{ hp.}$$

and for compartment (b)—

$$\frac{87 \times 22.6 \times 21.0}{715} = 57 \text{ hp.}$$

Total 194 hp.

The working out of the remainder of the test will present no difficulty.

Axial Sieve Test

The result of the axial sieve test is shown in Fig. 15.

To divide out the base line $EFGH$ of the graph, we require the horsepower per ton ground per hour for each compartment. This is found as follows:

$$\text{Preliminary mill, compartment } (a) = \frac{137}{5.85} = 23.40 = EF$$

$$\text{Preliminary mill, compartment } (b) = \frac{57}{5.85} = 9.74 = FG$$

$$\text{Finishing mill} = \frac{102}{5.85} = 17.42 = GH$$

$$\text{Total} = 50.56$$

The sieve residues on 180, 76 and 50 mesh, as obtained from the various samples, are plotted in the correct positions in relation to the power expended. The curve $ABCD$ is the reference line. Given the terminal residues on 180 mesh at A and D, it shows approximately what the intermediate residues should be, in relation to the power expended, when a uniformly hard material is being ground.

The positions from which samples were taken inside the mills are numbered 1 to 7 in Fig. 12 and 8 to 13 in Fig. 13.

It is unfortunate that a sample was not taken close to the feed end plate of the preliminary mill. It is apparent, however, that the clinker disintegrated to a considerable extent as soon as it entered the mill, since the feed had 100% residue on 180 mesh. The cause may have been internal strain due to rapid heating or cooling.

It is apparent that the grinding efficiency of the 3-in. diam. steel balls in the first compartment of the preliminary mill was not equal to that of the flints in the two following compartments.

General Conclusions and Notes on Test

The figures below relate to the efficiency of the discharge from each of the three compartments (a), (b) and (c), in Figs. 12 and 13:

	Compartment (a)	(b)	(c)
Charge volume, grinding bodies	21.6%	35.4%	37.6%
Ratio, material to voids	112.0%	52.0%	45.0%
Speed factor, Sf	192.0	194.0	176.0
Discharge opening, sq. in.	750.0	750.0	108.0

Comparing the material and void ratio for compartment (a) with that given for the I. C. Johnson mill, it will be seen that the arrangement of discharge slots in Fig. 14 had the effect of keeping down the quantity of material present in the compartment to a reasonable amount, although the charge per cent. of grinding bodies was smaller than before.

With reference to compartments (b) and (c), the quantity of material present in each case was perhaps rather small. It will be seen that neither the speed factor, nor the slot area, had much effect on the position.

Size of Grinding Mediums. After some provision had been made for breaking up the lumps, as they entered the preliminary mill, much better results could have been obtained by the use of smaller balls and smaller flints.

Horsepower Used. Contrary to the experience at I. C. Johnson's works, the horsepower absorbed by the mills (as checked by calculation) was apparently too large.

The electrical measurements were verified by a representative of the motor manufacturers, who used his own ammeter, voltmeter, and wattmeter, thus checking the instruments possessed by the research staff.

Each mill was driven by a tight and heavy belt from a 200-hp. motor, and the belt friction is included. It is possible that the makers overestimated the motor efficiencies given.

Subsequently the research staff obtained suitable apparatus for estimating motor efficiency under various conditions, and the hp. measurements became less open to criticism.

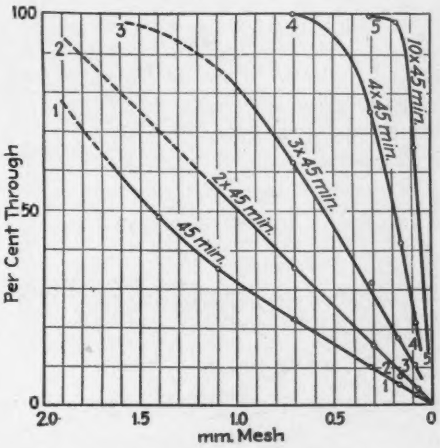
Erratum in Part I

After Part I had gone to press we were advised by the author of a slight error in the original manuscript. In the last line of Part I the value of Po was given as 707 whereas this should have been 770.

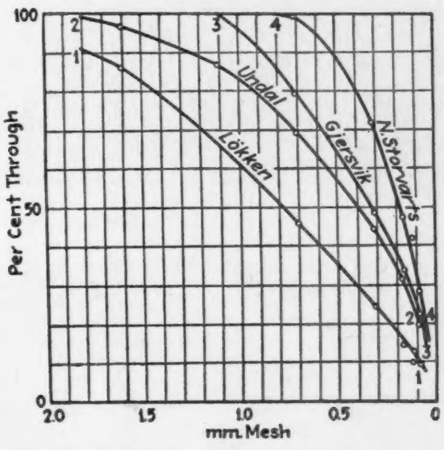
(To be continued)

Grinding Factors

MAGNE MORTINSON, Trondhjem, Norway, writes in the *Engineering and Mining Journal* of a method for determining the "grindability" of different substances.



Sieve analysis of quartz



Sieve analysis of Norwegian pyrites

Quartz rock is taken as a standard. Fig. 1 gives the curves of the sieve analyses of quartz ground for multiples of 45 min. in a laboratory tube mill.

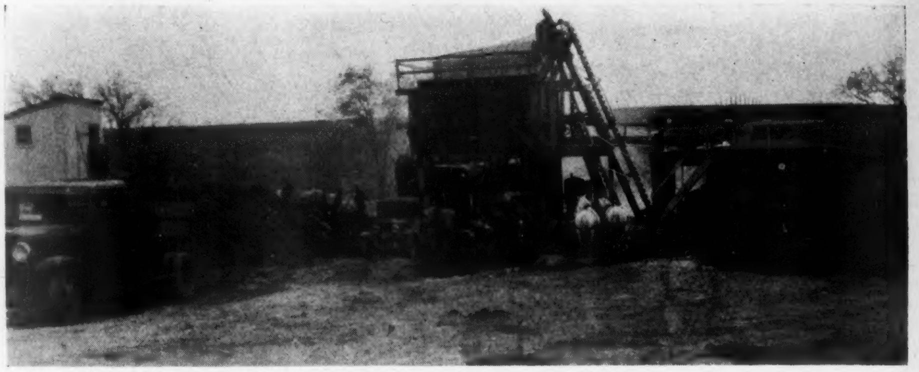
Comparisons are made on a basis of the time required to grind quartz and the material tested to the same fineness. The following factors were obtained: Pyritic ores, 2.5-4; magnetic ores, 3-4; fine grained granite, 3, gneiss, 3-4; sausorite gabbro, 2.7; soapstone, 8.

Typical Small Crushed-Stone Operation in Iowa

Winterset Limestone Co., Winterset, Iowa, Has One Crusher and Gasoline-Engine Power

IOWA is, as every one knows, the state "where the tall corn grows." It is a typical Central West agricultural state with few industrial centers. Its crushed-stone industry depends almost wholly on highway construction and on the farm demand for agricultural limestone. Most of the more important quarry operations are along the Mississippi river, near Davenport.

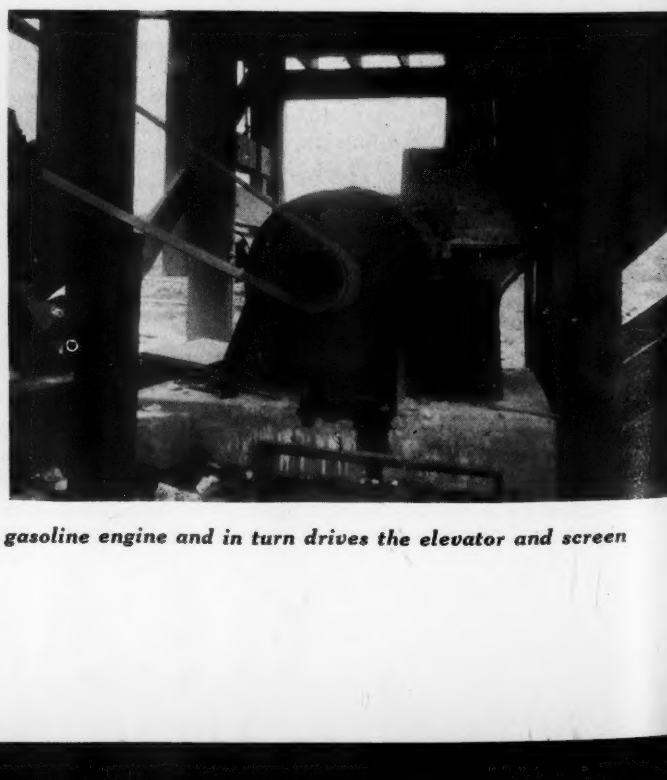
The state is largely underlaid with limestone, but in many places it is far below the surface, and there are few outcrops. Long hauls, a scarcity of paved highways compared to states east, and the restricted market outlets, as already noted, do not permit large operations. But small operations are growing in number, and doubtless fill a real place in industry. One of the most recent of these is that of the Winterset Limestone Co., Winterset, Iowa, in the south central part of the state. It is designed for only 50 tons per hour capacity but is interesting because it is typical of a part of the quarry industry all too frequently overlooked in current quarry literature.



General view of crushing plant

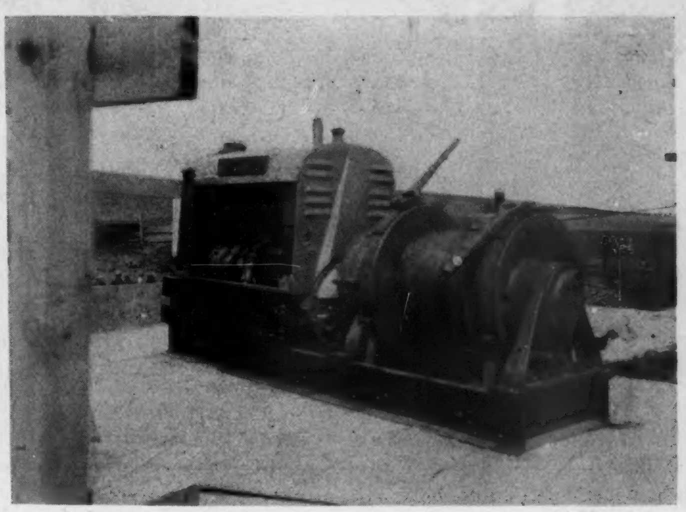
Quarry, with plant beyond

The operation is simplicity itself. A 25-hp. Buda gasoline engine direct-connected to a Sullivan single-drum hoist pulls the cars from the quarry to the plant, where they dump to a No. 6 Williams hammer mill, which serves as a primary, secondary and finishing breaker. It is the only crusher on the job. The crusher is belted to a 100-hp. Buda gasoline engine, which also drives the bucket elevator and rotary screen. These



Two views of the hammer mill which is belt driven from a gasoline engine and in turn drives the elevator and screen

Gasoline engine which drives hammer mill, elevator and screen



Gasoline engine and hoist used for pulling quarry cars up incline to plant

latter two items were manufactured by the General Conveying and Manufacturing Co. of St. Louis, but were supplied through the Williams Patent Crusher and Pulverizer Co. of St. Louis.

At first the cars dumped direct to the crusher, but this caused serious overloads, so that now the stone is hand fed from an inclined chute, and when fed in this manner no trouble is experienced.

Owing to the presence of streaks of unsatisfactory stone in the quarry it is not feasible to use shovel or power loading and so hand loading is to be followed in this new operation. Similar to the smaller quarries in south Iowa considerable overburden has to be removed. This is being done under contract. The stone is a limestone and is not washed at the plant.

Left to right, Karl Fischer, state inspector; George Horton, superintendent; K. C. Kastberg, designer, and G. D. Poarch, general manager

Even though the operation is comparatively small, a fully equipped drill sharpening shop is available, which includes a Sullivan drill sharpener and oil heater. A 310-cu. ft. per min. portable Sullivan compressor supplies air for the drills. Sullivan drills of the jackhammer type are used. These are provided with 1-in. steel.

During the season just past the plant has produced approximately 75,000 tons of stone.

All shipments are by truck, the plant having no rail connections.

The plant was designed by K. C. Kastberg, Des Moines, Ia.; G. D. Poarch is general manager, and Geo. Horton, superintendent.

Graphite

NATURAL GRAPHITE sold or used by producers in the United States for 1926-1930, inclusive, according to Department of Commerce, Bureau of Mines reports, are shown in the table below.

Only five companies reported for 1930 compared to eight for 1929, nine for 1928, nine for 1927 and six for 1926.

	Amorphous		Crystalline	
Year	Short tons	Value	Pounds	Value
1926	2,975	$40,500	4,989,200	$178,842
1927	2,595	35,850	5,224,400	197,121
1928	2,994	43,320	5,233,300	253,773
1929	3,555	46,650	5,806,410	264,241
1930	1,941	20,525	(*)	(*)

*Bureau of Mines not at liberty to publish figures.

During 1930 the demand for graphite fell along with prices, affecting adversely operations in most of the producing districts.

Total imports of graphite in short tons for 1930 were: Amorphous, 10,926; lump, 3,071; and crystalline flake, 2,729.

Explosives in 1931

ACCORDING to the United States Bureau of Mines report the total amount of high explosives used during the first 11 months of 1931 was 207,958,000 lb., a decrease of 26% from the corresponding period in 1930. The quarry and nonmetallic mineral mining industry used 24% of this total, or 45,864,161 lb. During the first 11 months of 1930 there was sold 64,791,925 lb. of high explosives to the nonmetallic mineral industries. Hence there was a decrease of 29% in 1931.

Asbestos

ACCORDING to the United States Department of Commerce, Bureau of Mines, the domestic production of asbestos for the years indicated was as follows:

Year	Short tons	Value
1926	1,358	$134,731
1927	2,981	336,882
1928	2,239	351,178
1929	3,155	351,004
1930	3,653	317,584

The imports of asbestos, for consumption only, were as follows:

Year	Short tons	Value
1926	257,621	$8,142,505
1927	223,693	8,150,340
1928	230,595	9,017,891
1929	262,427	11,153,017
1930	208,681	7,064,824

The average price for 1929 on all imports was $42.50 per short ton. For 1930 the average price was $33.85.

Mica*

MICA sold by producers in the United States for the years 1926-1930, inclusive, was as follows:

Year	Short tons	Value
1926	8,129	$536,827
1927	7,036	322,621
1928	8,601	363,378
1929	8,350	365,500
1930	7,465	286,407

*Department of Commerce, Bureau of Mines, report.

American Mining Law

THE Division of Mines, State of California, has issued the third edition of "American Mining Law," by A. H. Ricketts of the San Francisco bar. The new edition has been enlarged and revised to date. The book of over 800 pages states the subject matter and the principle or argument briefly and topically, coupled with citations to and excerpts from the full-text decisions. The book should prove valuable to the layman, to the lawyer, to the miner and engineer.

Lime Production Methods of Europe and America

Part IX—Mixed Feed Kilns

By Victor J. Azbe
Consulting Engineer, St. Louis, Mo.

THE ideal lime kiln in which high calcium lime is burned would, with good coal, turn out about 10 tons of lime per ton of coal. This ideal, however, is not even remotely approached by most kilns. A hand-fired kiln may have a ratio of 3½, and even to get this it would have to be a very good hand-fired kiln, well operated. As likely as not it may have a ratio of only 2½ to 1, only one-fourth of the theoretical possible ratio. A rotary kiln could be classed with the direct-fired kiln in fuel efficiency only. A gas-fired kiln would be higher up in the scale; it may turn out 3½ tons of lime, and, again, it may turn out 5½ tons per ton of coal, possibly even more if the coal is better and the design exceptionally good. To get much closer to the ideal 10 to 1 ratio with any of the above kilns is impossible. To do so one has to revert to the mixed feed, which, under best conditions, may give ratios as high as 7 to 1, and even more.

Occasionally one hears of better performances than those stated above, but they are either untrue or the coal may be exceptional or the stone of the magnesium or hydraulic lime variety. With the last, ridiculously high ratios are often actually obtained, but they do not in any way mean that the kiln efficiency is any higher; it only means that, due to its nature, the stone requires less heat.

Perhaps, in the future, cheapness of all commodities will be an essential for the survival of a concern. If so, it is certain that the hand-fired kilns will disappear one by one and be replaced under certain conditions by rotary kilns, and under certain others by either producer or natural gas fired kilns; but, in addition, we are bound to see more of the mixed feed variety, for reasons to be given in the following pages.

About all that still holds the hand-fired kiln is its simplicity, which is more apparent than real. Also, most of these kilns were built so long ago that if proper charges were made for depreciation they are all paid for. With the depreciation reserve built up in the proper manner, money should be available for replacement, but ordinarily they are not rebuilt, and, as the plant is practically paid for, overhead charges are light, which permit, to an extent, high labor, fuel and repair costs. This places the new plant at a great disadvantage, since to compete with the old, obsolete, poorly performing one, it must be so highly efficient that the lime produced is cheaper, with overhead on the high investment properly charged, than with the old plant where it is not charged at all or only in small measure.

However, not all hand-fired kilns are equally inefficient. There are some where, peculiarily, modernization would hardly pay. In the following tabulation fuel ratios are given of five hand-fired plants, their fuel efficiencies ranging from 25½% to as high as 37%; fuel costs per ton of lime vary between $1.23 and $2.15.

Modernization, if undertaken in the proper manner, would, in cases "A" and "C," certainly be justified; in the others it is more doubtful. In the following few paragraphs the case of Plant "B" is developed to see if scraping is justified.

A modern lime plant, exclusive of hydrating and quarrying departments, and including only kiln building, kilns, gas producers, gas flues, kiln plant portion of rock and fuel handling equipment, will cost about $1000 per ton per day capacity, with a variation of $300, more or less, the exact amount depending upon many items, including also the size of plant. For our purpose we will assume $1000 as the correct figure.

No plant can operate at 100% load factor; 75% is good and 50% frequent, although right at the present it is likely to be very low in most cases. Suppose then that we assume 60% as a reasonable average. The $1000 investment part of the plant then would produce 219 tons of lime per average year. This lime would have to carry, first, the interest charges, which would be $1000 \times 0.06 = \$60$ per year, and, second, depreciation charges, which would be $1000 \times 0.05 = \$50$ per year, or altogether $110, amounting to 50.4 cents per ton. If the old plant is not fully depreciated the new plant will have to also carry the remains, but if it is, only its own portion will be the burden, the approximate 50 cents per ton.

Assuming now this plant "B" with an average ratio of 2.65 to 1 with coal costing $4.45 per ton to be a 100-ton capacity plant. At 60% load factor it would produce 21,900 tons of lime in a year, with 8270 tons of coal costing $36,800, or $1.68 per ton of lime. A new gas-fired plant would certainly operate with a ratio of 4½ to 1, probably even 5 to 1, depending upon the design, but assuming 4½ with coal costing the same, the fuel cost per ton of lime will be 99 cents, or 69 cents less, already showing a profit over the 50-cent overhead burden.

But there are labor savings also. Producing 60 tons a day in a direct-fired plant means about five kilns and probably a 12-hour shift, a fireman to each kiln on each shift, doing their own drawing, making a total of 10 men. A gas-fired plant of equal capacity can readily save half of this, or five men, which, at $3.50 per day, amounts to $17.50, or 29.2 cents per ton. So altogether, fuel and labor savings equal $1.28, or 78 cents over the investment and depreciation charges.

If the new plant is more efficient or the efficiency of the old plant lower, or if coal is more expensive, or if the new plant cost is less than the stated $1000 per ton, or if the load factor is greater than the 60% assumed, the saving will be greater. If conditions are the reverse, the saving will be less, particularly if the old plant is not all paid for.

There are many other matters to consider, such as the power requirements and power costs. Direct-fired kilns need little power, although often steam is used. Producers need power; modern mechanical draft kilns also need power, and if this power is purchased at a high price its cost may eat seriously into the savings and reduce the 78 cents per ton difference quite considerable.

Then, there is the item of upkeep and repairs of kilns and producers. It may be that a direct-fired kiln plant with its many kilns will cost more in this respect than the high capacity kilns of a modern plant, not per kiln, of course, but per ton output. Espe-

FUEL RATIOS, COSTS AND FUEL EFFICIENCIES OF DIRECT-FIRED LIME KILNS

	Ratio, lb. lime to lb. coal	Heat value of fuel, B.t.u./lb.	Cost of fuel—Per ton	Cost of fuel—Per ton of lime	Fuel efficiency, per cent.
Plant A	2.33 : 1	12,000	$5.00	$2.15	26.8
Plant B	2.65 : 1	13,000	4.45	1.68	28.0
Plant C	2.04 : 1	11,000	3.75	1.84	25.5
Plant D	3.25 : 1	13,750	4.00	1.23	32.5
Plant E	3.75 : 1	14,100	7.00	1.87	37.0

cially when the kilns get very old and bulge in all directions, with tops corroded, arches sagging, and the upper sections in need of extensive repairs. Usually, when a plant gets into this state it is time to consider modernization.

Quite often it is possible to install a new plant for an operating load factor of 80 to 90%, instead of the 60% previously assumed, and help out with the old kilns during the peak producing periods. This complicates the plant somewhat, but at the same time, if conditions are right, saves considerably in overhead. The loss due to operation of obsolete kilns for two or three months is offset by continuous operation of a new plant, thus getting the most out of a given investment.

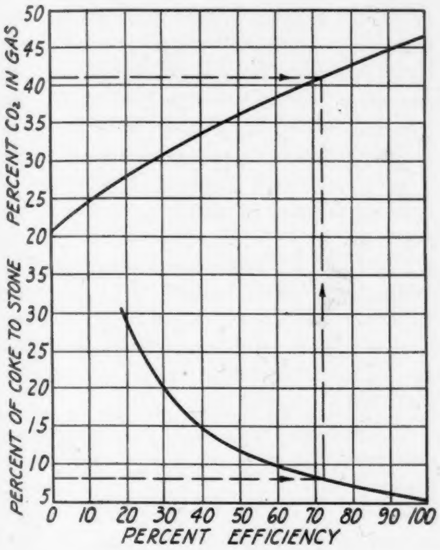


Fig. 108. Relation of percentage of CO_2 and coke consumption to kiln efficiency

However, there are many plants where, due to cheap coal and good kiln operation, modernization would apparently be a losing proposition. In cases like this it means a careful study into the market requirements as to quality also. Producer-fired vertical and rotary kiln plants give the best lime. Mixed-feed kilns are not quite as good, but both construction and operation costs of these mixed-feed kilns are decidedly less, and so they must receive serious consideration.

On the surface it would appear that the rotary kiln, due to its low fuel ratio, would be practically out of consideration. But the rotary has a very low labor cost, and also with a rotary kiln the quarry can be mechanized so that the stone need not be selected for size, but can be passed through the crusher and burned with a minimum of plant labor. If there is also a use for waste heat and the operation is large enough, the possibilities of a rotary become quite interesting in spite of its low fuel efficiency. When only small stone is available which would otherwise be wasted, the use of a rotary kiln becomes almost necessary. If the use of powdered coal can be considered, the matter becomes still more inviting. There are rotary plants of large capacity where, in spite of the faults of the rotary, the lime made is as cheap or cheaper than in any gas plant.

On the other hand, modern vertical gas-fired kilns of high capacity can be almost as efficient in labor as rotary kiln plants. They are far more efficient in fuel, as already stated, and have also a lower upkeep cost than the rotary. When operating under an induced draft system, as all should be, all stone above 4 in. and some below this size can be burned effectively. But the smallest sizes, if not ground or pulverized or used for some other purpose, have to be dumped, which loss in some very exceptional cases reaches 40%. The selection of the proper type of kilns depends upon many commercial and engineering factors. Both the gas-fired vertical and rotary kiln will be discussed in separate chapters later. It is the intention here to concentrate on the less known mixed-feed kiln.

Mixed-Feed Kiln More Efficient

The mixed-feed kiln is more efficient in labor, in fuel, in upkeep costs as well as in first cost, than any of the others. It can be forced to unbelievably high capacities. It often is operated for years continuously without any repairs. The kiln consists of a simple shaft, this not being so at all in the case of a gas-fired vertical kiln. A given diameter shell as a mixed-feed kiln could readily make three and more times the lime of a gas-fired kiln. Much smaller rock can also be burned efficiently.

But there are disadvantages also. The high fuel efficiency is partially offset by the higher first price of fuel, which must be either coke or anthracite. In some cases in Europe they use coal, but that is out of the question here, except in some very extreme cases. Then, also, the ash and whatever coke remains unburned is in the lime, and if the ash is of low fusing point it clinkers and fuses to the lime and the color is, to an extent, affected. Even with these disadvantages, however, when "low cost per ton" is an important consideration, serious thought must be given the mixed-feed kiln.

Certain chemical industries, particularly the manufacture of soda ash, burn limestone and utilize both the lime and the CO_2 gas evolved from the stone. These are almost more concerned with getting gas high in CO_2 than they are with high fuel ratios, but high CO_2 gives them also a high fuel ratio and invariably they use the mixed-feed kiln on this account.

There is a very direct relationship between the efficiency of a lime kiln and the CO_2 percentage in the waste gas. This is shown in Fig. 108. If the kiln efficiency were 100%, the gas from a kiln burning high calcium stone, when undiluted with excess air, would contain by volume around 47% CO_2. If there is a considerable portion of magnesium carbonate in the stone, the CO_2 would be even higher. These figures, however, cannot be attained, but a maximum figure of 43%,

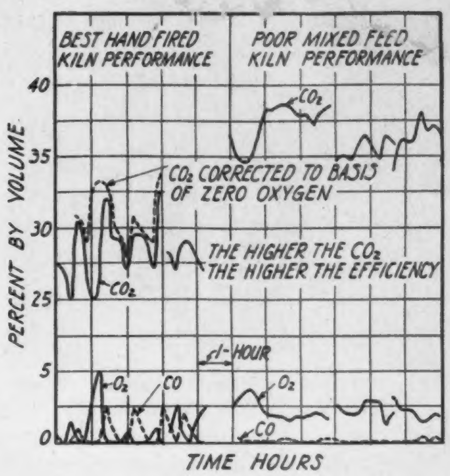


Fig. 109. Comparison of hand-fired and mixed-feed kilns

which corresponds to a kiln efficiency of 80%, is entirely possible. Fig. 108 shows also the relationship of coke consumption to efficiency and in turn against CO_2 percentage. As little as 7½ lb. per 100 lb. of stone is possible. In contrast, a direct-fired kiln would give an excess air-free CO_2 percentage of only about 29% with an equivalent coke consumption of 23 lb. per 100 lb. of stone.

A study of Fig. 109 is interesting, as it compares the waste gas analysis from the best operated hand-fired kilns the writer has seen with the gas analysis from a mixed-feed kiln of old-fashioned type operating under far from ideal conditions. The great difference in efficiency is plainly noted, as the mixed-feed kiln, even with gas diluted with some excess air, has a CO_2 content far higher than the direct-fired kiln.

As already stated, a mixed-feed kiln is operated either by mixing coke uniformly with the stone or by forming alternate layers of stone and coke, all feeding of both fuel and stone being done on the kiln top. An exception to this is the kiln constructed on the Allborg principle shown in Fig. 110, and the Spencer kiln which is used in Europe, particularly in England. In this case, coke

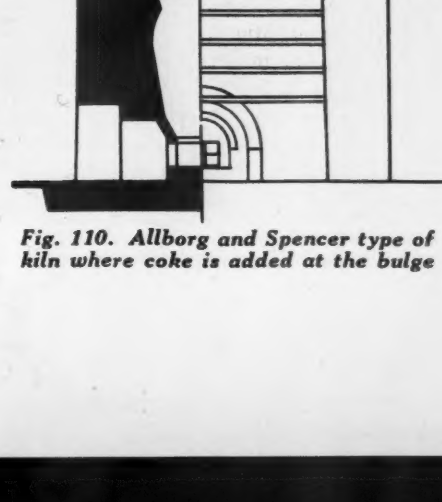


Fig. 110. Allborg and Spencer type of kiln where coke is added at the bulge

Fig. 112-A. Hand-drawing from mixed-feed kiln to conveyors

can be added into the bulge and the volatile matter distilled off has a chance to burn in its travel to the outlet.

With mixed-feed kilns, as the lime is drawn (which can be done by hand, Figs. 111 and 112, or mechanically, the latter either intermittently or continuously) the charge sinks and is replenished with more coke and more stone. In almost all cases all of the combustion air enters through the bottom of the kiln where the lime is drawn. The aim is to regulate the draw so that the lime comes out only warm to the hands. This means that all of its sensible heat was imparted to the entering air, and it is due to this, in a great measure, that the mixed-feed kiln is so much more efficient.

Large Cooler Very Important

. The cooler is a most important part of the kiln. Hand-fired kilns have them very shallow, 7 ft. or so, and even then all the air has to enter through the fire box and the lime is drawn hot, with almost all of the heat below 2400 deg. F. wasted. Some modern gas kilns have coolers much deeper, 15 ft., and most of the air passes up through them with the lime coming out comparatively cool, but even these coolers are of insufficient height if the kiln is forced. In both hand-fired and gas-fired kilns the cooler height is fixed. In a mixed-feed kiln one can vary it at will. By drawing faster, the fire zone is lowered and lime comes out hot. By drawing slower, the lime comes out cooler and the fire zone is transferred into higher portions of the kiln. In mixed-feed kilns the burning zone is at the middle or even higher in the kiln, while in direct-fired kilns it is down low.

Each pound of lime at 2400 deg. F. holds about 500 B.t.u. of sensible heat. If the kiln ratio is 6 to 1, this amounts to 3000 B.t.u., or almost one-fourth that in the coke and enough to preheat the air necessary for combustion to 1200 deg. F. Returning this heat, which in direct-fired kilns is mainly wasted, will of itself, aside from the other advantageous features of the mixed-feed kiln, improve its performance by one-third over the direct-fired kiln.

Then, mixed-feed kilns are more concentrated than direct-fired kilns, and far more than gas-fired kilns. Everything takes place within the kilns. There are no external furnaces, no producers, no gas flues, no large

Fig. 111. Hand-drawing from mixed-feed kiln to car

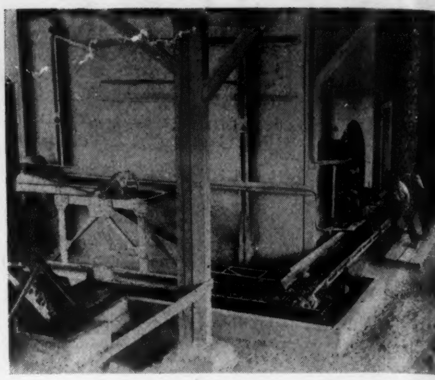


Fig. 112-B. Hand-drawing from mixed-feed kiln to conveyors

firing doors, either to let air in or gas out, or to lose heat by radiation. It is simple to thoroughly insulate the mixed-feed kiln. It is difficult and costly to do this properly in the widely spread gas-fired plant. Then, in a mixed-feed plant no one ever even thinks of using steam except to generate power. There is no such thing as blowing steam under the grates or through the bed of the producer, or, as is sometimes done, blowing it direct into the kiln to keep the lining from fusing. This steam is costly to generate and is responsible for the lowering of the kiln efficiency, as it increases the volume of total gas in the kiln and so lowers temperature potential.

A direct-fired kiln has to be charged on top, drawn at the bottom and continuously fired in the middle, and when this firing is performed in the very best and most expert manner it still is wrong, as there is a continual fluctuation of heat generated. Every quarter or half hour a man has to be fiddling with the furnaces. Every two to six hours he has to clean them, cooling the kiln seriously when doing this. Then there is the sticking and punching and trimming of the kiln at every draw. In the case of a mixed-feed kiln this is all quite different. The kiln is charged on top and drawn at the bottom. When drawn it is charged, but not necessarily so.

Fig. 113. Mixed-feed kilns showing gallery around top

Fig. 114. Coke is spread on top by hand

In the meantime there is nothing to do, the fuel goes into the kiln with the stone, the ash comes out with the lime, the kilns never stick or should never stick, and the operation is continuous, without any interruptions. Much of the labor and most of the hard labor is saved.

Charging Apparatus Also Important

Of course, for best results the charging is not quite as simple as one may infer from the above. Much thought has been devoted to the charging apparatus of mixed-fired kilns, since good performance of a properly proportioned kiln is dependent only upon proper charging and proper drawing, and of the two, proper chargings of coke and stone are the most important.

In the simplest installation there are galleries around the kiln top, as in Fig. 113. Stone is dumped from a cart and distributed with a hoe, and coke is spread on top by hand, as shown in Fig. 114. This is all right when the capacity is low or the plant small.

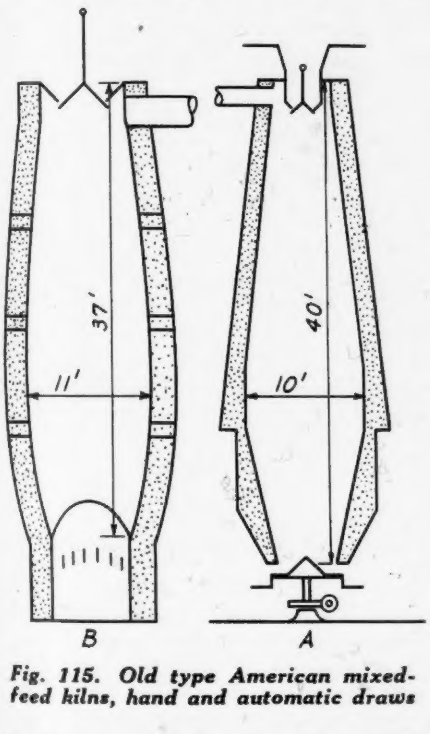


Fig. 115. Old type American mixed-feed kilns, hand and automatic draws

For high capacities it naturally is costly from a labor standpoint, and mechanical charging is resorted to, although there are still some large plants retaining the hand-feed method.

In the old kilns the shaft had all kinds of queer shapes, as shown in Fig. 115. Modern kilns have, however, straight shafts or shafts that taper in very slightly towards the top. There are no bulges such as in the two just shown, as these seriously harm the even down flow of the lime. Tests made on Kiln *A* of Fig. 115 by charging fire brick and timing their passage revealed the surprising fact that some came through in 11 hours, although according to the kiln size and capacity at which it was operated two days would have been the proper time. What happened was that the lime was drawn out of the center too fast and too slowly from the sides. Under such conditions the results cannot be of the best, neither can the lime be of uniform quality. With straight shafts, however, and when the draw portion of the kiln is designed right, the lime comes down very evenly. This even down flow is very desirable, but is neither possible nor desirable in gas- or direct-fired kilns, because in these the heat is not the same over the entire cross-section. Certain zones on one level are hotter than others, and so the hanging of the lime and punching is necessary. If one could apply the same amount of heat to each square foot of the direct- or gas-fired shaft they could all be slip kilns and much simpler to operate, but this condition can only be approximated. In mixed-feed kilns this is different, as part of the heat is generated where the coke lays, and where the carbon is converted to carbon monoxide, the other part where the carbon monoxide is burned, which is likely to be close to the first reaction. By careful charging of coke one regulates the uniformity of the burn.

In direct- and gas-fired practice the quality of the fuel plays a great role, and there are the questions of heat value, ash content, fusibility of the ash, amount of volatile matter, caking characteristics, size of coal, etc. In the case of mixed-feed kilns quality is also an important consideration, but for different reasons. Naturally, the higher the heat value of the coke, the better, but that heat value must be in the fixed carbon portion. If there is any volatile matter in the coke its heat is all wasted in the upper kiln portions. The coke should also be hard to ignite, for if it has a low ignition temperature it will start to burn too soon and the heat will be used to preheat rather than to calcine the stone. The ignition temperature of some coke is about 1100 deg. F. If it was 1500 deg. F., at which temperature the limestone begins to decompose, it would be far better. This difference between the ignition temperature of coke and the initial decomposition point of stone is, in a way, detrimental to lime kilns of this type.

The ash percentage in coke is important because it remains in the lime, to be removed, in the main, by the hydrator. The extent of this removal depends, however, on the nature of the ash. Does it fuse into a clinker or have ingredients tending to discolor the surface of the lime? Generally speaking, however, the ash does a lot less harm than one would think.

First, as shown crudely in Fig. 111, the lime is passed over a grid or grizzly. When the small lime containing the fuel ash is separated, this small lime could be hydrated to a medium grade hydrate. The lump lime passing over will be practically free of ash. It may be slightly "painted" with ash, but the amount would be hard to discover in the analysis.

Assuming that we have good coke of about 10% ash and a kiln fuel ratio of 6 to 1, the amount of ash in the 12,000 lb. of lime would

Fig. 116. Uniform, medium-sized feed

be 200 lb., or 1.6%; but very little of this would be in the lump lime. Natural impurities in lime run around 5%, and the ash in lump lime would increase this figure very little. With a proper air separator on the hydrator the percentage of impurities in the hydrate would also be increased very little. So that, apart from the slight discoloration, the difference in lump lime burned in mixed kilns with good fuel and in gas producers would be small. It may even be in favor of mixed-feed kilns if unburned core be considered as an impurity. Mixed-feed kilns will burn lime so that there will be a mighty small loss on ignition. One plant, to the writer's knowledge, averaged less than 1% for an entire year. As the lime was used for manufacturing carbide, this was important. As far as color is concerned, one may also say that mixed-feed kiln lime is hardly any worse than, if as bad as, direct-fired kiln lime, which, due to incomplete combustion of hydrocarbons, often is quite discolored.

In mixed-feed kilns a wide range of stone can be burned which would be entirely out of the question in other types of shaft kilns. Of course, uniform medium-sized stone, as shown in Fig. 116, is to be preferred, but ununiform with quantities of spalls (Fig. 117) also is burned. For this kind of stone forced draft is desirable; in fact, forced draft operation of all mixed-feed kilns is to be preferred, as they are better adapted to it than any other kiln. With forced draft, if the kilns are of the proper height, tremendous capacities become possible without in any way impairing kiln efficiency. If small stone

Fig. 117. Feed containing fines and requiring forced draft

is burned it should preferably be sized into 6 to 4, 4 to 2½ and 3 to 1½ in., and the size of the coke should have a relation to it. If the stone is large and the coke small, it will dribble between the pieces, making proper distribution impossible. Some of it may sift all the way through the kiln, while much of it may burn too soon. If it is too large its burning may require so much time that it may extend into the cooler.

Fig. 118, after Berthold Block, the keen student of mixed-feed kilns, pictures how large coke burns slower, how it stretches out the burning zone and thus tends to create a more equal temperature and also a better, more complete calcination of the stone. Small coke, on the other hand, burns fast, gives high local temperatures, dead-burns the small lime lumps, and incompletely burns the large, also tending to wear overly much the kiln lining.

While coke breeze is not a very desirable and is in fact an ordinarily impossible fuel, mixed-feed kilns are the only ones in which some measure of success can be obtained with it, and as coke breeze is cheap, being a waste product, its use often is desirable, in spite of the above-mentioned undesirability. There is really nothing fixed in all of this. We know that certain sizes are desirable, but the coke size should vary with the stone size. The price one has to pay for the different sizes is a factor, and the stone sizes will vary with the type of the plant and the ability to otherwise dispose of the spalls. Much will also depend on how clean the lime must be and how important is uniformity of burn or completeness of burn with cleanliness of the final product. Also, can cheap coke or anthracite be obtained, is there any use for kiln gas, what is its desirable strength? If the lime plant is only one arm of the chemical plant, what effect will variation have upon the rest, and so on?

In mixed-feed kilns it is the very long life of shaft lining between repairs, periods of time that figure into years, that appeals particularly to one. The direct-fired kiln often has a very short life, just a few months, and when that extends to six or eight, the operating force begin to congratulate themselves. This is due to the high concentration of heat in a limited zone. In the mixed-feed kiln it is different. In no other kiln can the fire be kept as well from the walls or distributed so widely and so uniformly as in the mixed-feed kiln. The coke does not burn all at once. It burns rather slowly, immediately adjacent to it is the stone, or the lime with some remaining stone, which is a very effective cooling agent, keeping the heat from climbing to excessive heights. In a direct-fired kiln precombustion takes place in the firebox, and when the gases enter the kiln they are at a temperature of 2500 or 2600 deg. F. and the first charge that this intensively hot stream meets is completely burned lime, itself intensely hot and incapable of taking on much heat. The stream thus has to travel some distance before it gets into a zone where it loses some of its heat. So it is quite natural for the walls directly above the fireboxes to slag with the lime and melt.

In the mixed-feed kiln this is all different. Combustion of the coke begins high up where there is still raw stone, which draws heat almost as fast as it is generated. Lower down the combustion is more intense and the temperature higher, but here, while there is much lime, all of the lime still contains considerable core, so almost as soon as heat is generated it is abstracted. Still lower down most of the stone has been burned into lime, but also most of the coke is burned and the partially preheated air coming up from the cooler arrives in the combustion zone here and abstracts larger quantities of heat, thus holding the temperatures down.

Coke as it comes down through the upper kiln zones is thoroughly dried and preheated by the ascending waste heat. In no other type of kiln does this occur. In every other type the preheating of the fuel and evaporation of its moisture takes place at the expense of the heat that would otherwise be making lime. Considering the heat necessary to preheat the fuel, to evaporate the moisture, and the heat that this water vapor carries from the dissociation zone in the kiln, all three losses together make a difference in production of 1000 lb. more lime per ton of fuel from the mixed-feed kiln than from any other. One would not think that this item could be so large, but it certainly is if the moisture content in the fuel is as much as 10%.

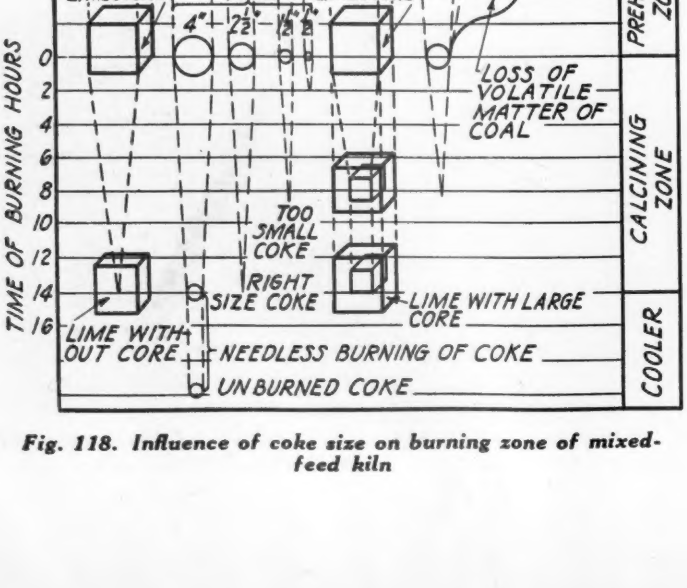


Fig. 118. Influence of coke size on burning zone of mixed-feed kiln

Direct-fired kilns, and to a lesser extent gas-fired kilns, have very high waste gas temperatures. The reason for this is not so much that the kiln is low as that, due to the poor fuel ratios, there is so little limestone coming down to cool the hot gas leaving the zone of dissociation. The upper region of the zone of dissociation has a temperature around 1600 deg. F. when the stone is high calcium. From this level the gas can be cooled only by preheating the stone. If the ratio is 3 to 1, as in direct-fired kilns, naturally much higher top temperatures will prevail than if the ratio is 6 to 1, as in the case of mixed-feed kilns. The average top temperature of the direct-fired kiln will be around 600 deg. F., much higher just before charging stone and naturally much lower after charging. In the case of mixed-feed kilns the average temperature will be 300 deg. F. and less, depending upon the design and operating care.

As with anything else, if mixed-feed kilns are to be successful they must be designed right and operated with a fair degree of care. If it were only a matter of dumping coke and stone in on top and drawing the lime out at the bottom, it would be too simple even to be interesting.

There are mixed-feed kilns only about 20 ft. high and others close to 100 ft. Some are very wide and some very slender. Kilns of large diameter tend to cause unevenness of flow of rock and lime down and of gas up; they are more difficult to charge properly, and more difficult to draw. Long gas paths and high velocity from a heat transfer standpoint is far better than a short, sluggish flow. Very high velocity, however, means mechanical draft, but no other kiln is so well adapted to either induced or forced draft as the mixed-feed kiln.

(To be continued.)

Cement Markets of Paraguay

THE following table shows cement imports of Paraguay for the last three years for which such figures are available.

Source	1927 Bbl.	1928 Bbl.	1929 Bbl.
Argentina	756	3,753	8,514
Germany	6,126	8,125	7,382
Belgium	3,336	5,585	6,512
Denmark	1,059	1,797	905
United States	106	32	233
France	147	180	5
Switzerland	371	1,481	4,285
United Kingdom	......	60	......
Uruguay	......	159	......
Yugoslavia	......	......	529
Italy	......	......	106
Russia	......	......	233
	11,901	21,172	28,704

The above figures include cements of all types imported.

The outlook for building new roads, or improving those now in use, is not promising.

It is stated by a local importer that European cements are preferred by most Paraguayan buyers because practically all cement workers are Europeans.

The above information is contained in special circular 19 of the minerals division of the Bureau of Foreign and Domestic Commerce.

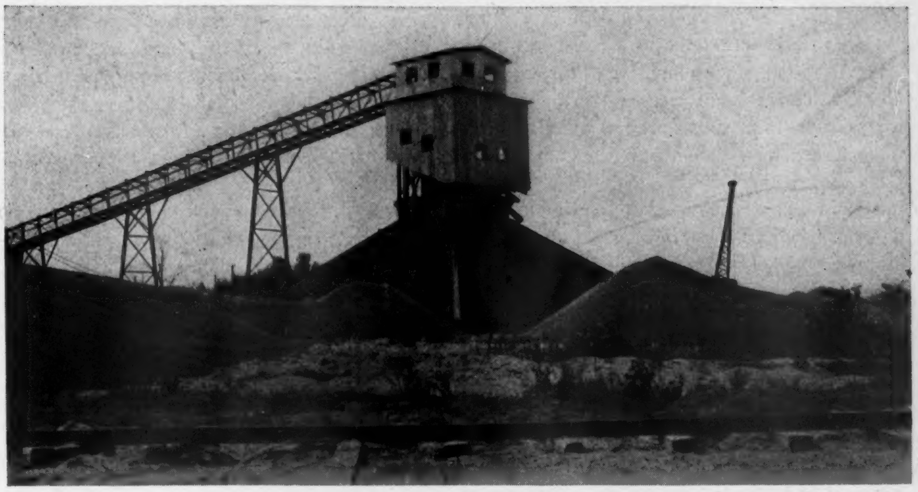
Storage Systems for Concrete Aggregate Plants

By E. M. Stevens
Consulting Engineer, St. Louis, Mo.

THE IMPORTANCE of suitable storage systems in connection with concrete aggregate plants has been given too little consideration by the large majority of the producers throughout the country. We often read of a "modern well designed plant" with only a small storage of a few hundred tons, consisting of a series of bins of wood, steel or concrete, and in some cases only small hoppers for loading purposes. Some provide bins of two or three carloads each, while a very few of the larger producers will provide bin capacities of 40 to 50 cars by an expensive system of concrete bins or silos, all of which do not produce the results that should be obtained from a storage system.

Then there are still a small number of large producers who, rather than construct expensive bins, have resorted to ground storage by means of overhead and underground conveyors. Such a system generally produces good results, but the cost per ton of stored material is very high, and the "dead" storage can't be recovered without the additional expense of cranes or drags. These systems, however, are very satisfactory.

The writer has visited many plants throughout the country and seldom has he found one where any particular effort has been given to the proper method of storage, but in all cases he has observed large stock piles along the entire track system of the plant, in which the material has to be stocked by locomotive cranes and recovered by the same method. Such a method of handling stock is not so bad for one kind of material, but for supplying various sizes of concrete aggregate it is out of the question.



Central tower with conveyor from pit

Considerations of Design

In designing a new plant the storage system should be the first thing to be considered and it should be treated as part of the plant equipment, and the most important part so far as dividends are concerned.

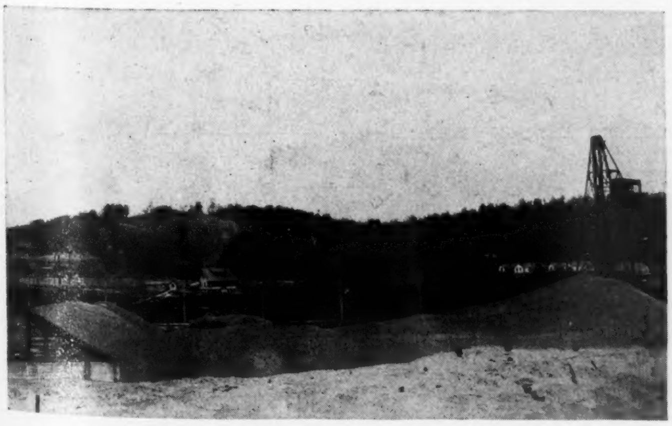
The location of the plant should be such that a ground storage of at least 25% of the yearly capacity can be installed. If a designer of an aggregate plant will take this into consideration he can install a suitable storage system at little or no expense. For example, if a producer desires a plant with a capacity of 200,000 tons per year, his engineer will, as a rule, start from the quarry or pit and continue through to the screens with equipment of sufficient size to supply this amount. But if he will at first consider a proper storage system of 50,000 tons, he can purchase equipment all along the line having a capacity of 150,000 tons, as the storage will increase this amount to the required 200,000. There is very little difference in the cost of a plant per ton of output whether it has a storage system or not.

Reasons for Large Storage Capacity

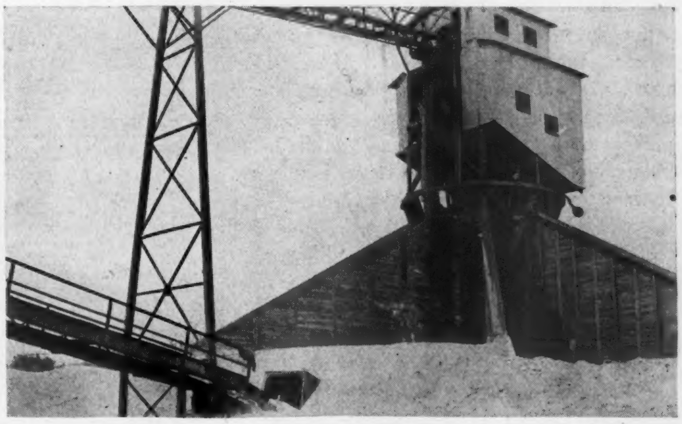
There are many other reasons why a storage system should be included in the design of a good plant. The operation on the production end is entirely independent of the shipping department, and if properly handled will take care of all fluctuations in shipments and natural shutdowns of the plant.

Severe losses occur in plants having no storage due to days of small shipments, overtime, with night and Sunday operation during heavy shipments, and delays that occur caused by natural breakdowns of the plant when no shipments can be made.

During the winter season when the demand is very limited the producer oftentimes



Looking across storage pile toward movable 60-ft. tower



Loading conveyor in foreground with central tower beyond

has to keep his entire force and his plant in readiness for production at any and all times in order to supply his regular customers, but the producer with a well filled storage at the end of the season can shut down the production end of his plant for a few weeks when the operating expense is excessive.

Effects of More Rigid Specifications

I have often heard it stated that the new rigid specifications coming into general use and demanded by construction engineers and architects are working a hardship on and "slowly bankrupting the producers of aggregates." Such statements have appeared in ROCK PRODUCTS, and I agree there should be a standard set of specifications for all classes of concrete, which should be the same in one place as another; but instead of working a hardship on the producers it is proving to be a benefit by causing them to install suitable storage with proper mixing devices, which in turn proves to be the best part of the plant as far as profits are concerned.

The designing engineers for the producers have done more toward starting them into financial failure than all the specifications for aggregates ever written.

However, poor management, unethical methods of business, price cutting below cost of production, and many other causes are more serious reasons for the financial stress of the producers than any of the specifications they have been compelled to meet.

Design of a Specific Storage System

The writer was recently connected with one of the largest producers in the Middle West, having a yearly capacity of 750,000 tons, but with no storage system whatever except stockpiling along the tracks of the plant with cranes, and no adequate method of recombining the different sizes of materials after being placed in the stock piles. Shipments could be made fairly well through the small bins for one specification at a time, but any excess material had to be loaded into cars and taken to the stock piles until such a time as it could be used for other classes of work.

The only storage, therefore, was in the source of supply, and on many occasions it required overtime, night and Sunday operation, with several men, locomotives and cranes handling surplus one way or the other, to meet the demand. Then all of a sudden, two or three hours' run would be sufficient, due to rainy weather or other causes.

How well do we know of hundreds of plants operating under the same conditions. In fact there are very few that are not, and it is not very difficult to realize the excessive cost of production under such conditions.

The only thing to do was to install a suitable storage system at the lowest possible cost, with the minimum amount of equipment, proper mixing devices, operation, maintenance and all other points favorable or unfavorable to any system to be considered, with a capacity that would make the operation of production entirely independent of shipments through the entire year.

After many weeks of investigation and considering half a dozen different systems it was decided to install a radial system such as shown by the cuts in plan and elevation, designed and patented by the Fred T. Kern Co., Milwaukee, Wis.

Radial System Described

This system consists of a tower 12 ft. in diameter, around which are walls or partitions dividing the circumference into eight sections. On top of the tower are located all the screens and washing equipment needed for the plant.

The different sizes of material are very easily distributed into their proper sections by chutes. At the bottom of the tower, which extends into the ground a certain distance, depending upon conditions, each section is connected to a belt conveyor by a gate which enables the feeding of material from any one section or any number of sections in quantities desired. The conveyor leads to the loading hopper over the tracks. After the gates are once set there is no variation, and any specification can be easily supplied.

The "dead" storage is maintained by means of a drag scraper from a 60-ft. tower on a circular track extending around the storage space. When any section is full the drag operator pulls the material away and continues to do so whenever production exceeds shipments. The operation is reversed when demand is greater than production.

In smaller plants where the amount of material to be handled will not justify the investment of a drag tower and circular track a combination of scraper and boom machine will be an efficient substitute.

The loading conveyor has a capacity 50% greater than the capacity of the plant, which is very important during peak demands.

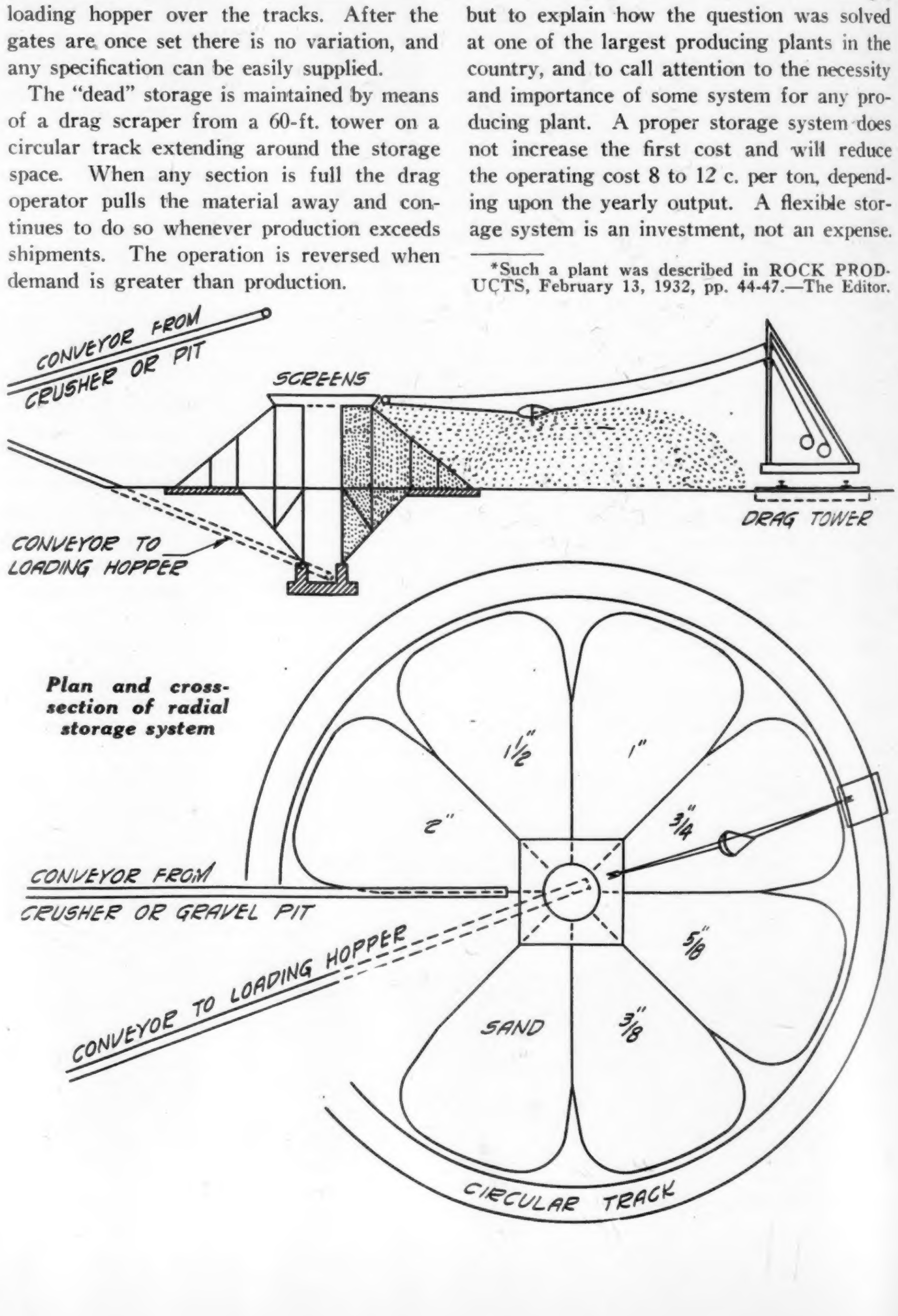
This storage system has increased the capacity of the plant 25%, provided constant daily operation regardless of shipments, does not retard shipments due to plant delays, and enables the operator to meet any specification that may be presented with a few minutes' notice.

In the design of a new plant this radial tower costs very little more than a series of bins in an ordinary plant, supporting the screens and other equipment, and when installed a large part of the storage system is already provided.*

Conclusions

This article, however, is not intended to advocate any particular system of storage, but to explain how the question was solved at one of the largest producing plants in the country, and to call attention to the necessity and importance of some system for any producing plant. A proper storage system does not increase the first cost and will reduce the operating cost 8 to 12 c. per ton, depending upon the yearly output. A flexible storage system is an investment, not an expense.

*Such a plant was described in ROCK PRODUCTS, February 13, 1932, pp. 44-47.—The Editor.



Plan and cross-section of radial storage system

Analyzing Power Contracts to Reduce Power Bills

By R. H. Bacon
R. H. Bacon and Co., Chicago, Ill.

IT MIGHT APPEAR that in periods of poor business there is no necessity to investigate the subject of power contracts. However, as a matter of fact, this is a subject that deserves very careful study at such times when the plant output is very low and when power costs form a relatively higher part of total operating costs.

There are not many industries that have a more difficult power problem than plants producing crushed rock or sand and gravel. This is due primarily to the fact that the loads on the individual motor drives vary throughout a wide range. Due also to the fact that these motors may be practically idling part of the time, the power factor is quite low. It is not uncommon for a plant of this character with a fairly good output to operate on a 30% load factor* and with a power factor† of 60%.

In loads of this character the public utilities have often been criticised for their rate structures. Naturally, the plant owner, whose power bill is about half demand charges and half energy charges, does not have a very kindly feeling towards demand meters and power factor clauses; but the public utilities can present a very strong case as to the soundness of their rate structures when handling loads of this type.

It is not within the province of this article to go into a discussion as to whether power rates are too high or whether, in view of the difficulties connected with serving this type of load, the rates are too low. The purpose is to make some general observations on power contract clauses with a suggestion that a careful study be made of plant operations to see whether certain optional clauses in almost all power contracts cannot be utilized to reduce the total power bill.

Basis of Rate Structures

Although rate structures vary considerably in different parts of the country, they are all based on certain fundamental principles. As a rule the standard form of contract calls for demand charges, energy charges and minimum charges. The optional features may cover whether the demand charge is to be on a monthly or yearly basis, and, if yearly, whether it is to be an average of three half-hourly maximum demands in a month. The energy charge and the demand charge are usually set up on a step basis and the minimum charge may call for a monthly or yearly charge. Demand may be figured on a 10- or 30- or 60-minute interval, depending upon the type of load and policy of the power company. Then there may be optional limited hour service clauses, auxiliary or reserve service clauses, and the possible discount for furnishing untransformed service.

In making a study of plant operations to determine possible savings in power bills, it is usually good practice to place the issue squarely before the power engineers of the public utility company. As a matter of good business practice they are, or should be, willing to assist any of their customers in reducing operating costs. Often the public utility company also benefits from certain changes which can be made in operating methods, with consequent reduction in demand charges or improvement in power factor. Where power lines are heavily loaded and voltage fluctuations have become annoying to other consumers, or where the power factor is unusually low, the utility company may be more interested in correcting the situation than in the slightly increased revenue that may result from such conditions.

In order, however, to come to any conclusions as to possible changes that may be made, it is necessary to have a reasonable understanding of the type of load represented by the operation of the plant and a very definite knowledge of how the power bill is figured.

Example of Rate Analysis

For purposes of illustration an analysis of a plant producing crushed stone for road work and screenings for fertilizer will be used to throw some general light on the subject. This plant has a connected load of 315 hp. with a maximum demand that varies from about 75 to 105 kw. The motor drives in the plant are as follows:

1— 5-hp. motor driving pit pump.
1— 75-hp. motor driving air compressor.
1— 40-hp. motor driving pulverizer.
1—100-hp. motor driving } crushers
1— 40-hp. motor driving } crushers
1— 20-hp. motor driving } crushers
3— 5-hp. motors driving bucket elevators.
1— 20-hp. motor driving bucket elevators.

A study of the demand meter chart covering a two-day period of operation shows how the half-hourly demands vary from hour to hour. It so happens that the peak of 89.6 kw. on this chart represented the maximum half-hourly demand for the month and therefore set the demand charges for that particular month. During that month the energy consumption was 8000 kw.-hr.

The particular power contract for this plant called for a demand charge of $2.50 per month per kw. for the first 50 kw. of maximum demand and $2 per month per kw. for the next 450 kw. of maximum demand. Thus, since 50 kw. of the maximum demand was figured at $2.50 per kw. and 39.6 kw. at $2, the gross demand charges for the month were $204.20.

In this contract the energy charges began at—

5c per kw. for the first 1,000 kw.-hr.
4c per kw. for the next 2,000 kw.-hr.
2c per kw. for the next 2,000 kw.-hr.
1.2c per kw. for the next 25,000 kw.-hr.
0.9c per kw. for the next 70,000 kw.-hr.
0.8c per kw. for the next 400,000 kw.-hr.
0.7c per kw. for consumption in excess of 500,000 kw.-hr. in the month.

This part of the rate, therefore, is figured as follows:

1000 kw.-hr. at 5c	$ 50.00
2000 kw.-hr. at 4c	80.00
2000 kw.-hr. at 2c	40.00
3000 kw.-hr. at 1.2c	36.00
8000 total	$206.00

The total gross power bill for the month

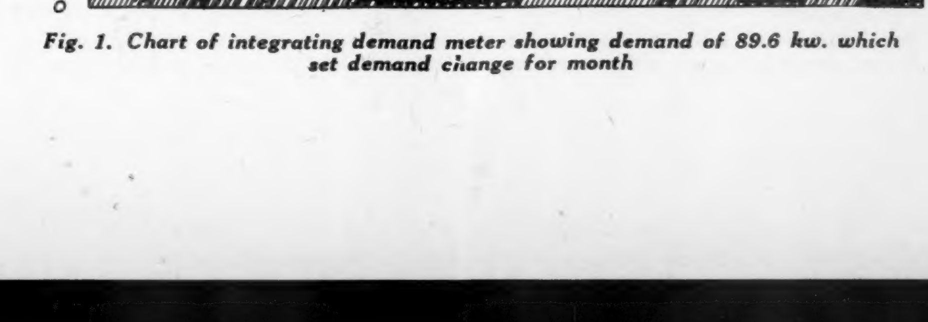


Fig. 1. Chart of integrating demand meter showing demand of 89.6 kw. which set demand change for month

*Monthly load factor = $\frac{\text{Actual kw. hr.}}{720 \times \text{maximum demand}}$

†Power factor = $\frac{\text{Actual power}}{\text{Apparent power}}$

was, therefore, $410.20, and with a discount of 3% for cash in ten days of $12.30, the net power bill was $397.90.

Although the study of the demand meter chart gives some idea of the variation in half-hourly demand, it does not by any means tell the whole story as to the load fluctuations. The demand meter is an integrating type of instrument in that it shows the average peak load for the half-hour. If an indicating type of instrument is used the picture of a half-hour load is of the type shown in Fig. 2. From this chart it will be noted that the peak load ranged as high as 178 kw., although the averages for the two half-hours covered were 65.6 kw. and 67.2 kw. respectively.

There is no question but what this type of a chart indicates some justification for setting rates on a demand charge basis. If this particular plant were to install its own generating equipment it would have to base the installation on a momentary overload capacity of at least 180 kw. If the equipment were installed on the basis of meeting the half-hourly demand requirements the overload requirements and the voltage fluctuations might produce serious results on the equipment. In all fairness to the public utility companies it must be kept in mind that the distribution lines and the generating equipment must be able to handle momentary load fluctuations far beyond those shown with half-hour demand meters if the service is to be at all satisfactory.

It is advisable to make a periodical check on plant operation and to study the peak contract provisions to see what can be accomplished in reducing the various charges. It may even be possible to get the power company to agree to a rider on the contract which will enable the plant to operate under one of the optional clauses.

In the analysis which has been made of a typical power bill, the demand charge is figured on a monthly basis; that is, the highest half-hourly demand during the month sets the demand charge. Many companies also have an optional yearly demand charge which may, in some cases, be based on the average of three half-hourly maximums in the month. Every time this average demand increases it sets the rate for the next succeeding 11 months unless in one of such months a higher maximum demand occurred. When the yearly demand charge is in effect it is usually lower than the monthly demand charge. For plants that operate on a reasonably uniform basis throughout the year this type of demand charge may reduce the total power bill. It must be admitted, however, that plants in the rock crushing and in the sand and gravel field are not in quite such good position to take advantage of yearly demand schedules as is the case in other industries.

One of the major points of conflict between the power companies and users at the present time is in connection with minimum charges. It is fairly general practice to have a clause in the contract calling for a minimum charge of 50 cents per horsepower per month of the total rated capacity of the motor or motors. When the plant is operating at a reasonable capacity this minimum charge is exceeded, and therefore it does not ordinarily come into the picture. The moment a plant closes down entirely it becomes a very important subject.

There is also the question as to whether the minimum charge should be on a monthly or yearly basis. In some contracts the minimum charge is based on 50% of the highest demand charge billed during the last previous 11 months of the term of the contract. In this case it may be limited to a certain minimum demand such as 200 kw. The following typical yearly minimum charge is from a contract in fairly general use: "It is agreed that the customer shall pay the company, instead of the monthly minimum charge specified in said contract, a yearly minimum charge at the rate of $12 per horsepower or fraction thereof of the total rated capacity of the motors, such minimum charge for any contract year to be based on the highest total rated capacity of motors connected at any one time during said contract year." The contract then goes on to state that "the company agrees that in so far as any such monthly minimum payment shall represent an excess over the regular charge for electric service in such month, such excess shall, after the actual minimum charge for such a year is fully paid, be allowed as a credit against bills for service in subsequent months in such year." This yearly minimum charge gives the user a greater degree of flexibility during months when the plant may be closed down or where it is operating on a part-time basis.

This can be explained more clearly by assuming that in the plant under discussion the operations for the first three months of the year were such as to call for the minimum charge and also for the last four months of the year. The following tabulation might very logically indicate the power bill for the year based on a monthly minimum charge and based on a yearly minimum charge:

	On monthly minimum basis	Actual power bills	Credit
January	$ 315	$ 200	$115
February	315	150	165
March	315	160	155
April	390	390	......
May	410	410	......
June	600	600	......
July	750	750	......
August	600	600	......
September	315	240	......
October	315	180	135
November	315	160	155
December	315	120	195
	$4955	$3960	$920

Those months where the minimum charge of $315 applied on the monthly basis, but where actually the power bill was under that figure, would come in for a credit as soon as the total yearly guarantee to the power company had been paid out. Under these conditions there is a credit of $920 where the yearly minimum charge is in effect as compared with the bill that would have been paid if the contract had been on a monthly minimum basis.

In some cases power companies are willing to take contracts on a basis of waiving the minimum charges during the four winter months. This is based on the assumption that if a crushing plant is closed down in the winter months, the power company can sell that amount of connected load to some other customer. In that case the crushing plant is not required to carry its portion of the fixed charges on equipment that has been set aside to serve its load.

At the time that a power contract is to be signed it is good practice to analyze the motor applications with considerable care to see that none of the drives are over-motored. If the motors are larger than actually necessary for the drives, it not only increases the minimum charge but it also reduces the system power factor. Even in plants that have a connected load of less than 100 kw. a curve drawing wattmeter may be a very good investment. With this instrument it is possible

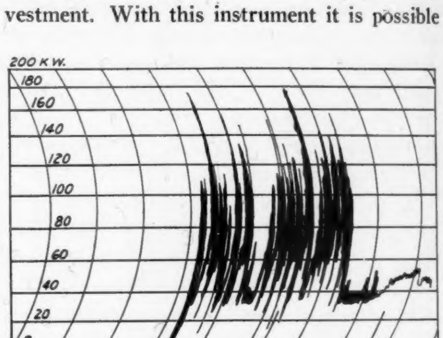


Fig. 2. Chart of indicating demand meter which shows load fluctuations up to a maximum of 178 kw. during periods when average demands for half-hour periods were 65.6 and 67.2 kw.

to analyze the demand charges in considerable detail and to check up on the plant operations as a whole. It is not uncommon to pay for the cost of the instrument in two or three months in the reduction in demand charges which can be effected.

It is also wise for a plant to keep a daily record of the kilowatt-hours and tons or cubic yards of output, so that power costs may be studied in detail. When contracts are under consideration, or whenever it is desired to study the economics of private generation of power, these figures are of considerable value.

Power Factor Clauses

A number of important utility systems in the country now have power factor clauses in their rates which are set up on a bonus basis. A few years ago it was usual to talk in terms of power factor penalty clauses, in which case the loads with lower power factors were penalized with higher rates. The power companies have found, however, that this was not good selling psychology, and where such rates are now in effect they are

usually figured on increased discounts for improved power factor. One well-known company, which has pioneered in this type of rate, has the following contract provisions relating to power factor:

Power factor	Additional discount
74.9	None
75 to 79.9	1%
80 to 84.9	2%
85 to 89.9	3%
90 to 94.9	4%
95 to 100	5%

This same company also has a clause in the contract stipulating that they may refuse service to customers whose average power factor is lower than 70% between the hours of 7 a. m. and 5 p. m.

The only difficulty in basing power contracts on power factor has been in a satisfactory method of measuring power factor. The general practice at present seems to be to base this on a ratio of kilowatts to kilovolt amperes. This is a reasonable basis for figuring a rate, since the customer is interested in kilowatts and the power company is interested in keeping down the kilovolt amperes which must be supplied. As far as the power company is concerned, the capacity of the generating equipment and of the distributing system is limited by the heating effect and voltage drop, both of which are in direct ratio to the kva. supplied to the customer. When the power factor is unity there is no reactive component and therefore no added losses over and above the usual line and transformer losses.

Unfortunately, there is not very much that can be done in the correction of power factor in plants of the type under discussion. Synchronous motors are not particularly well fitted for drives in the rock products industry, although some progress has been made in the utilization of such equipment. Improvement in power factor usually comes about by the better application of induction motors and in the use of some of the newer types of power factor correction equipment of the condenser type.

Energy Charges

Energy charges are practically always based on some kind of a step rate, which varies quite widely in different parts of the country. Larger consumers benefit very materially by the lower brackets, although as a rule the demand charges remain the same regardless of energy consumption.

It is not uncommon to have a rate that goes below 0.5c per kw.-hr. where the consumption is in excess of 500,000 kw.-hr. per month. In most cases the demand charges range from $2 to $2.50 per kw. per month, with some provision for reducing the rate per kilowatt of demand in the higher brackets.

By careful attention to operations it is often possible to reduce the maximum demand. Conveyors may be stopped before crushing begins and other similar methods may be used to stagger operations to keep the maximum demand down to a reasonable figure. If this does not involve any excess labor cost it is an excellent practice.

Limited Hour Service Clause

Another rider that may be attached to a contract is for limited hour service. A typical clause of this type is as follows: "The customer agrees that during any peak period [such peak period is specifically defined, as from 4 p. m. to 8:30 p. m. in the months of November, December, January and February] his maximum demand in kilowatts will not exceed 20% of the highest monthly maximum demand recorded during the eight consecutive months immediately preceding the four months contained in such peak period." This form of contract usually stipulates that the company can discontinue supplying electricity in excess of such 20% at any time during any peak period.

When the customer complies with such an agreement the company allows an annual discount at least on the net demand charges for the previous 12 months on some such basis as the following:

Ratio of maximum demand during peak period to maximum demand during the 8 months preceding the 4 months contained in such peak period:	Discount expressed in percentage of net demand charges
Up to and including 5%	25%
Over 5% and up to and including 10%	15%
Over 10% and up to and including 15%	10%
Over 15% and up to and including 20%	5%
Over 20%	None

There are so many cases in which the limited hour service clauses are handled that it is impossible to cover them. The point to keep in mind is that such optional clauses are available and that it is often possible to take advantage of them by rearrangement of the working hours.

When a customer furnishes his own transformers and buys high-tension current it is usually the practice to grant a further discount of approximately 10% of the gross bill. Where a service is furnished untransformed and measured on the primary circuit, although the power company furnishes the transformers, the discount is usually about 5% of the gross bill. Clauses of this type also offer interesting possibilities for study. If the fixed charges on the transformer equipment are less than the amount of the discount it may be desirable to install transformer equipment and purchase power on an untransformed basis.

Since public utilities companies are in business to sell energy, they are not usually very much interested in furnishing auxiliary or reserve service. They are, however, very anxious to retain the good-will of their potential customers, and for that reason auxiliary or reserve service for emergency use in connection with private generating plants can usually be obtained. The minimum charge in such cases may be about $20 to $30 per kw. per year paid on a monthly basis on the guaranteed demand specified in the contract.

Ropeways and Cableways

A RECENT issue of *Cement, Lime and Gravel*, London, England, contained a paper on the above subject by T. D. Stonehouse, given before the Derbyshire branch of the Institute of Quarrying.

The ropeway was defined as being of two types, single and double, the single ropeway both supporting and transporting the load by means of buckets attached to it, while the double ropeway has two supporting ropes upon which the skips are hauled by a separate rope. Ropeways have been built to handle normally 300 to 1000 lb. loads and with capacities up to 200 tons per hour. For a handling capacity of 50 tons per hour the first cost of a ropeway system is given as approximately $15,000 per mile and the operating cost (including overhead) as 6 c. per ton mile.

The cableway, on the other hand, is really a crane where the movement is along a cable stretched above the workings. It consists of a heavy main cable supported between a head and tail mast and on which a load carriage is pulled back and forth by means of an endless haulage rope passing around a drum. The carriage has a sheave through which the hoisting rope passes to a second drum. Both drums are of the same size so that when rotated together the load will travel without being raised or lowered.

The ropeway is not adapted to transport in quarries but rather for distance haulage. Some of the advantages cited for cableways in quarries were: elimination of tracks, easier loading of skips than higher car bodies, increased facility and lower cost of handling skips, handling in one operation from quarry to disposal point, easier working of high faces in benches without inclines, ease of working lower levels, handling large blocks and stripping, inspection of working face and handling of tools, supplies, etc.

The loads handled by cableways are commonly 3 to 7 tons, although a 20-ton cableway was recently installed in Scotland. They are used with spans up to 3000 ft. and with mast up to 185 ft. high. The masts, particularly the tail mast, are sometimes mounted on carriages which are movable on a track. The speed of operation ranges from 12 to 30 trips per hour. The first cost of a 5-ton electrically-operated cableway of 600 ft. span was stated to be $17,000 erected and the operating cost, 4 to 6 c. per ton.

Modern Blasting Practice

THE HERCULES POWDER CO., Wilmington, Del., has issued a book, Modern Blasting in Quarries and Open Pits, by J. Barab, which contains a complete and well illustrated review of modern drilling and blasting practice and is written primarily for quarry operators.

This book is intended to furnish data accumulated from the field and other authoritative sources, in an accessible form that will be available for practical use.

Where the Highway Dollar Goes

An Analysis by the U. S. Bureau of Public Roads of Vital Interest and Value to Every Producer of Highway Materials

A STUDY to determine the extent to which expenditures for highway improvement provide employment has just been completed by the Bureau of Public Roads of the U. S. Department of Agriculture. Concrete pavement was selected for this study because it is a widely used type and because the effect of expenditures for pavements of this type in providing employment is believed to be typical of the effect produced by expenditures on other high-type pavements. The effect in this field also appears to be typical of that produced by expenditures for public works generally.

All forms of construction have a wider influence on employment than appears generally to be recognized, though the points at which this influence is applied differ. An expenditure for the erection of a steel bridge probably results in about the same gross payment to labor as the same expenditure for a concrete pavement, but the distribution of the payments that are made to labor affect a somewhat different group of industries and in neither case is the distribution the same that results from the construction of a monumental building. But this is of little consequence, for, though this distribution reaches different industries, in all of these cases the general effect on business and on employment appears to be about the same.

In making this study, expenditures were traced through the various industries that are affected by them and the amounts paid as wages and salaries were set aside for accumulation. In the end, labor was found to receive the larger part of these expenditures, which is an altogether reasonable conclusion, since the materials entering into highway construction are of little value in their original state. Practically all of the value which the finished pavement possesses is created by the application of labor directly and through manufacturing processes and transportation.

For the purpose of indicating how labor creates the value of the finished concrete pavement, the following primary subdivision of its cost was made:

1. *The direct cost of laying concrete pavement (production expense)*
   - *a.* Labor
   - *b.* Aggregate
   - *c.* Cement
   - *d.* Steel
   - *e.* Equipment

These items cover the labor employed in connection with the various operations incident to laying the pavement, the cost of the materials of which the pavement is composed, and the costs represented by the equipment used.

2. *Expense, other than for production, incurred in connection with laying concrete pavement*
   - *f.* Getting on to job and installation of plant
   - *g.* Bonds and insurance

The first of these items covers the preliminary expenses incident to this work, such as the cost of getting equipment on to the job, the cost of employing men, the cost of developing a working organization, etc. The second item covers the cost of bonds and insurance and all closely related costs.

3. *Job margin*
   - *h.* Overhead
   - *i.* Financing
   - *j.* New profit

Such items as overhead (which includes central office salaries, rented quarters, the cost of bidding, etc.) and the cost of financing must be paid out of the job margin. After these and related expenses are satisfied, the remainder is the net profit on whatever money is invested in the enterprise.

An extended analysis of the cost of laying concrete pavement in three typical states during the calendar year 1929 produced the following distribution of costs among the above-named items:

TABLE 1. AVERAGE COST OF A CONCRETE PAVEMENT

		Cents per sq. yd.	Dollars per $1000 of expenditure
Item a.	Labor	$0.26	$141
Item b.	Aggregate	.60	324
Item c.	Cement	.60	324
Item d.	Steel	.05	27
Item e.	Equipment	.18½	100
Item f.	Getting on to the job and installation of plant	.05	27
Item g.	Bonds and insurance	.04	22
Items h, i, j.	Job margin	.06½	35

In order to ascertain the amount of labor involved in each of these items (except *Item a*, which already is a labor item), the study included an intensive analysis of their component parts. This analysis resulted in a distribution of the costs these items involve under nine headings—labor, freight (principally railroad freight), materials and supplies, fuel, interest, taxes, depreciation and repairs, depletion, and profit. Freight charges cover both the cost of delivering finished materials to the materials yard of the job, and the cost, if any is involved, of accumulating the raw materials, fuel, etc., used in producing such manufactured materials as cement and steel. The details of these analyses are not repeated here, but the results appear in Table 2 at the foot of this page.

The largest single item in Table 2 is "Freight—$406.70," which is about 40% of the cost of concrete pavement construction. Of this amount $313.70 is for transportation of aggregate, cement and steel. It covers the collection of the components of these materials prior to their manufacture, and the shipment of the material to the construction jobs. The cost of assembling the materials out of which they are built is nearly a third of the total cost of concrete pavements. The remainder of the freight charge is for the equipment and the movement of the numerous materials that enter into the manufacturing processes and subprocesses other than those noted above.

If this item (freight) is distributed on the theory that the railroads handle this business, the distribution shown in Table 2 reduces to that shown in Table 3. While by far the larger part of this freight is handled by the railroads, a little moves by water and a somewhat larger volume is moved in trucks. However, substantial accuracy is preserved if all of it is treated as railroad freight business.

TABLE 2. SUMMARY OF THE VARIOUS STEPS THROUGH WHICH THE CONTRACTOR'S PAYMENT OF $1000 ARE TRACED AND THE AMOUNTS ATTRIBUTABLE TO EACH

Item	Salaries and wages	Freight	Materials and supplies	Fuel	Interest	Taxes	Depreciation and repairs	Depletion	Profit	
a. Salaries & wages	$141.00	....	....	....	....	....	....	....	....	
b. Aggregate	50.00	$194.00	$18.00	$11.00	$ 4.00	$ 6.00	$ 29.50	$ 7.50	$ 4.00	
c. Cement	61.00	113.50	30.00	22.50	4.50	5.00	53.50	3.00	31.00	
d. Steel	6.00	6.20	8.50	1.50	.40	.90	2.50	....	1.00	
e. Equipment	5.20	4.50	10.65	.50	.20	7.20	70.65	....	1.10	
f. Getting on to job	13.50	13.50	....	....	....	....	....	....	....	
g. Bonds & insurance	11.00	....	....	....	....	....	....	....	1.00	*$10.00
h. Job margin	15.00	....	....	....	5.00	5.00	....	....	10.00	
	$302.70	$331.70	$67.15	$35.50	$14.10	$24.10	$156.15	$10.50	$48.10	$10.00
** Adjustments	....	+75.00	—50.00	....	....	....	—25.00	....	....	....
	$302.70	$406.70	$17.15	$35.50	$14.10	$24.10	$131.15	$10.50	$48.10	$10.00

*Set aside for later redistribution.

**These adjustments are made here to avoid recasting the freight analysis on account of the freight charges which are a part of the cost of repairs, replacements, materials and supplies.

TABLE 3. DISTRIBUTICN OF FREIGHT COSTS

1.	Salaries and wages	$ 477.70
2.	Materials and supplies	57.55
3.	Fuel	57.20
4.	Interest	61.70
5.	Taxes	49.70
6.	Depreciation and repairs	184.65
7.	Profit	91.00
8.	Depletion	10.50
9.	Redistribution	10.00
		$1000.00

If the cost of fuel as shown in Table 3 is distributed between the remaining items, Table 4 results.

TABLE 4. DISTRIBUTION OF FUEL COSTS

1.	Salaries and wages	$ 516.00
2.	Materials and supplies	64.20
3.	Interest and rents	63.75
4.	Taxes	51.40
5.	Repairs and depreciation	188.75
6.	Profit	91.00
7.	Depletion	14.90
8.	Redistribution	10.00
		$1000.00

From the last of these tables it is clear that, although job labor receives only a little more than 15% of the sum expended on the construction of a concrete pavement (see *Items a* and *f* of Table 2), the labor involved in producing the materials of which such pavements are constructed, in transportation and in obtaining the necessary fuel, is so large that the distribution to salaries and wages on account of these phases of the construction of such pavements is well in excess of half of its total cost.

Of the other items that appear in Table 4, there are three, "Repairs and depreciation," "Materials and supplies" and "Taxes," which evidently involve a large expenditure for salaries and wages. The ramifications of the first two of these classifications involve so many manufacturing processes that a more generalized analysis was applied to their reduction. However, though more generalized, the line followed was the same as that used in examining the expenditures of which there is more exact knowledge. This analysis is not repeated here, but when Table 4 is amended in the light of this analysis and in the light of the use made of taxes in paying employes and purchasing materials, it is found that as these payments filter through the various industries affected by them, something more than three-quarters of the money paid to contractors is converted into salaries and wages and less than one-quarter becomes the property of owners, who receive it in the form of interest, rents, royalties and profits.

This is about as far as the quantitative analysis may be carried with approximate certainty. But although the quantities become somewhat doubtful, there is still a further share for labor in the last quarter of the expenditure.

The preceding quantitative discussion is based on a period of unusual business activity. In times of depression such as the present, the residue composed of interest, rents, royalties and profits shrinks both in absolute amount and in relation to the total. In view of this well known fact, it seems probable that, of the total expenditures for road construction at the present time, nearer 85 than 75% may be thus directly traced into the hands of labor. Beyond this there is still to be considered the fact that a part of the money paid to owners is immediately reinvested or expended, even in periods of depression, although a greater part is certainly so used in more prosperous times. And since, of the money so reinvested in productive industry, labor again receives the major part, it is not unreasonable to suggest that as much as 90% and probably more of the original expenditure for a concrete pavement ultimately finds its way into wages and salaries and that this percentage is not greatly changed by the turn of the cycle from prosperity to depression and back again.

Occurrence of Fluorine in Phosphate Rocks

IN A RECENT ISSUE of *Industrial and Engineering Chemistry,* H. L. Marshall, K. D. Jacobs and D. S. Reynolds, Bureau of Chemistry and Soils, Department of Agriculture, give the results of 137 analyses made on phosphate rock for fluorine content. The samples came from 34 different locations throughout the world. Fluorine was found to be a characteristic constituent of phosphate rock, and the content of fluorine ranged from 0.40 to 4.25%. In general, phosphate from continental deposits had a higher fluorine content than from the island deposits.

It is interesting to note that while the fluorine content of phosphate rock is relatively small, the domestic reserves of phosphate are so large that the total fluorine content of the reserves is 75 times the fluorine content of the known fluorspar reserves of Illinois and Kentucky. The article quotes an authority indicating that there are 6,500,000,000 tons of phosphate rock containing 60% or more of tricalcium phosphate. This would indicate that if the fluorine content were taken at an average of 3%, as the authors suggest, there would be 195,000,000 tons of fluorine in the phosphate reserves.

Crude Artificial Abrasives

THE accompanying table on artificial abrasives is of interest, as it shows the extent of the entire abrasive industry, when combined with natural abrasive tonnages, which are given in another table.

Contractors' Surety Bon ls on Public Improvements

A SUMMARY by Edward H. Cushman of the bond requirements of the various states on public work has been issued in pamphlet form by the National Association of Credit Men, New York City.

This summary shows that 44 states as well as the Federal Government now require contractors on public work to furnish a bond for the protection of labor and material men. Kentucky, New York, Rhode Island and Vermont have no express bond legislation.

The amount of bond required is generally 50% or more of the contract price, and any suit on it must be brought within one year.

The Federal statute provides that suit cannot be brought until six months after completion and acceptance.

In Ohio the material man must furnish the surety with a statement of the amount due within 90 days after acceptance and cannot bring suit until 60 days after furnishing the statement. When the bond is less than the loss to the municipality or state, it may recover the full amount and the material man cannot share. In Pennsylvania the contractor must furnish two bonds, one to protect the municipality and one 50 to 100% of the contract price to protect labor and material men. The material man may bring suit within 90 days after furnishing the last material, but not later than one year after final settlement. Thus the rights of the material men and the municipality or state are independent.

Annual Report of Bureau of Mines

THE ANNUAL REPORT of the Bureau of Mines for the fiscal year ending June 30, 1931, has been published.

During the year a total of $2,945,357.01 was spent by the Bureau of Mines in all of its various activities, the report states.

In the nonmetallic section the bureau continued its studies of operating methods, and during the year nine reports of individual operations were published. These reports cover mining methods used at two fluorspar mines, quarrying and crushing of stone at three cement plants and at one trap rock operation, dredging and treatment methods at two sand and gravel plants, and milling at one feldspar plant. In addition to this, seven other papers have been prepared for publication and 94 others are in various stages of preparation.

CRUDE ARTIFICIAL ABRASIVES SOLD, SHIPPED OR USED FROM MANUFACTURING PLANTS IN THE UNITED STATES AND CANADA*

	Carbides		Aluminum oxides		Metallic abrasives	
Year	Short tons	Value	Short tons	Value	Short tons	Value
1926	17,026	$1,702,037	43,967	$4,106,699	12,610	$942,429
1927	26,289	2,603,571	50,973	4,516,637	13,364	839,683
1928	22,162	2,286,518	59,103	5,640,901	18,466	904,629
1929	30,309	3,060,401	72,614	6,471,373	23,789	1,289,922
1930	22,008	2,047,188	46,465	4,067,148	16,428	977,037

*United States Bureau of Mines Reports.

Lime and Portland Cement for Masonry Mortars

Being the Second of a Series of Three Articles on Masonry Cement

By F. O. Anderegg, Ph.D.
Consulting Specialist on Building Materials, Pittsburgh, Penn.

Synopsis

DR. ANDEREGG'S first article on "Analysis of Properties Desired in Masonry Cements" was published in Rock Products, December 5, 1931, pp. 40-41. The present article consists chiefly of a tabular comparison of those properties as exhibited by lime and portland cement. A third article will discuss "Practical Methods for Testing Masonry Cements." The three articles comprise much practical information on the subject that will prove helpful to manufacturers and users alike.—The Editor.

LIME has properties which make its presence eminently desirable in mortars for masonry. Portland cement has other properties which differ markedly from those of lime and which make its presence also of great benefit to masonry mortars. In a broad sense the two are hardly competing materials, but should be regarded as supplementing each other. According to this conception, best results are obtained by balancing the two according to the conditions of brick-absorption-rate, time of year, and joint thickness, as has already been pointed out. (1)

The portland cements sold in this country meet certain specifications and have a rather small range of properties; for instance, the water requirement of neat cement to produce normal consistency usually lies in the range 22 to 27%. With limes, on the other hand, the water taken up to form a putty varies over a considerable range. Some quicklimes give as low a yield as 2.5 cu. ft. of putty per 100 lb., while with others as high as 5.5 cu. ft. may be obtained. This means a great difference in the ratio of water to solid. A comparison of the strengths of 1 : 3 mortars made from low-yield and from high-yield limes (and such a comparison can be made between the finger tips) indicates very plainly that the water-lime ratio is of importance, much as the more famous water-cement ratio is. Because of these variations among limes, it is not safe to reduce the cement content too far.

A comparison of the properties of limes and portland cements is given in the table and it will be noted that portland cement and lime both have limitations in certain regards for masonry work and certain advantages in others. Hence the obvious desirability of balancing these two materials.

The volume change properties of mortars are complicated and a great deal has yet to be determined about them. As pointed out by Professor Davis, (3) and confirmed by the writer, (1) they vary greatly according to whether the specimens have been made in metal molds, or in contact with absorbent material, as happens in masonry construction. Again, the "packing" in horizontal joints helps take up some of the shrinkage, although this seems to occur in certain localized spots more than in others, leaving capillaries through which moisture flows with facility. In the vertical joints, it is obvious that there is no opportunity for such an effect, and shrinkage cracks are all too common in vertical joints. The elimination of these shrinkage effects has already been discussed. (1)

At present there are more than 40 masonry cements on the market, which vary in their properties from mixtures of lime containing 20% of portland cement to those where the portland cement predominates. Some have placed too much emphasis on workability and have an adverse water-cement ratio, while others have gone a little too far toward high strength for best all-round results.

References

(1) F. O. Anderegg, *J. Am. Cer. Soc.*, 13,315 (1930); *Architectural Record*, September, 1931; *Brick and Clay Record*, October 6, 1931.

(2) L. A. Palmer, *J. Res. Bureau of Standards*, June, 1931.

(3) Davis and Troxel, *Trans. Am. Concrete Inst.*, 25,248 (1929).

	Lime	*Portland Cement*
Water requirement to form a putty	Medium to high About 100 to 300%	Low About 25%
Workability	Good 100%	Poor 60%
Sand-carrying capacity	Good 100%	Poor 70%
Strengths:		
Bond strength (modulus[1])	15 lb. per sq. in.	100
Compressive[1]	200 lb. per sq. in.	4000
Volume changes:	Depends upon joint thickness	
Initial shrinkage		
Mortar specimens made in metal molds	0.50%[2]	0.17%[2]
Mortar in contact with masonry		
Horizontal joints	Much less	Much less
Vertical joints	Somewhat less	Somewhat less
Due to moisture change		
Mortar specimens made in metal molds	Below 0.01%	About 0.05%
Mortar in contact with masonry	Below 0.01%	About 0.01%
Setting time	Long	Short
Durability	Varies with water-lime ratio	Good
Density	About 75 to 85%	About 90%
Flexibility	Almost too much	Almost none
Efflorescence:		
Content of salts in	Low, below 0.1%	Low (white) to medium 0.3% (some grays)
Prevention of that due to rain saturation	Poor Both need stearate waterproofing	Medium
Staining (Indiana limestone)	Low	Low (white) to bad (some gray)

Oil Flotation Process in the Nonmetallic Field

THE OIL FLOTATION process is rather new to the rock products industry but each year new applications of this concentration process are being noted. Phosphate rock, bauxite, fluorspar, graphite, etc., are a few of the mineral products now being treated by the oil flotation process.

To those who wish to learn more of this process and its application, the reader is referred to "A Manual of Flotation Processes" by Arthur F. Taggart, published by John Wiley and Sons, Inc., New York City. While this book is not new to metallurgical engineers, it may be of value to those in the rock products industries who wish to learn more regarding the workings of the oil flotation process. The book deals with the elementary principles of oil flotation, laboratory testing equipment and methods of testing, and concludes with mill data.

What the Water-Cement Ratio Theory Means to the Aggregate Producer

An Abstract of F. H. Jackson's Paper Read at the National Sand and Gravel Association's Convention

By Edmund Shaw
Contributing Editor, Rock Products

AT THE ANNUAL CONVENTION of the National Sand and Gravel Association at Pittsburgh, F. H. Jackson, engineer of tests of the U. S. Bureau of Public Roads, presented a paper on "Designing Concrete Mixtures by the Water-Cement Ratio Method." It is one of the clearest expositions of modern ideas of concrete mix design that has been published.

In introducing the subject Mr. Jackson admits that the results of this method (which he has advocated for the past three years) seem to discriminate against gravel. Hence he welcomed the opportunity to discuss the subject fully before the association.

The best known method of proportioning concrete, he said, is the arbitrary mix, the familiar 1:1½:3, 1:2:4 or other such proportions. It has only one point in its favor, simplicity. The product will not be constant in either strength or yield. Proportioning by weight or by absolute volume is preferable because it will control the yield regardless of the grading of the aggregates, and strength variations will be less than with arbitrary proportions. Methods of design based on water-cement ratio, surface area, surface modulus, and mortar voids mark efforts of investigators to consider factors known to affect concrete strength. Of these the familiar water-cement ratio theory is the best known and most widely applied, and Mr. Jackson considered it the most satisfactory basis of concrete mix design yet proposed.

Quality of Aggregates an Important Factor

However, this method does not take into account a variable appreciably affecting the strengths which will be obtained with a given water-cement ratio—the quality of the aggregates used. By this is meant those characteristics inherent in the aggregates themselves, such as surface texture, absorption, mineral composition and so on. The effect of such characteristics is quite different from the effects of variations in size or gradation. Such variations may be taken care of in the application of the water-cement ratio, changing proportions of fine to coarse to improve workability while maintaining the water-cement ratio constant. But experience has demonstrated beyond a doubt that the other physical characteristics mentioned do materially influence physical strength, all other factors such as grading and water-cement ratio remaining constant.

To illustrate: Tests showed that of two aggregates, one required a water-cement ratio 0.20 less than that required by the other for the same flexural strength. This meant a difference of about one bag of cement per yard for equivalent strength. Plotting the four series of tests made in three years with different water-cement ratios and different cements shows that the differences were not accidental. As a result a cement factor of 7 bags was called for with one aggregate and 8 bags with the other, the water-cement ratios being 0.60 and 0.80, both corresponding to a modulus of rupture of 650 lb. The contractor used the higher cement factor (8 bags) because the aggregate was available locally and transportation costs were saved; control tests of beams (with a different cement) made every day averaged 614 lb., indicating that the required beam strength (600 lb.) would not have been secured except by using this relatively high cement factor. This example well illustrates the advisability of studying the concrete making properties of aggregates before setting proportions for concrete.

Also this probably illustrates about the maximum range of differences in strength. But it is by no means an isolated case. The joint investigation of the Bureau of Public Roads and New Jersey Highway Commission in 1928 found for a water-cement ratio of 0.72 a flexural strength of 525 lb. with one aggregate and 580 lb. for another, each the result of 52 tests. In Tennessee in 1931 an average of 111 beam tests gave 763 lb. modulus of rupture with one aggregate and an average of 32 tests gave 629 lb. with another. Similar results have been obtained in Georgia, Wisconsin and other states.

It should not be assumed that gravel always gives lower results than crushed stone. Bureau of Public Roads tests have indicated that some characteristic or combination of characteristics, independent of type, is probably responsible for variations in strength. This is shown by the fact that certain gravels gave just as high transverse strengths as the best of the crushed stones. The point is that the influence of aggregate characteristics is sufficient to warrant consideration in the design of mixtures.

Flexural Strength Basis of Pavement Design

The forces tending to destroy a paving slab are natural agencies and traffic loads. Natural forces tend to keep the slab under stress, due to changes in volume from changes in heat and moisture content. The resistance to such change by the friction on the subgrade stresses the concrete in tension if the slab contracts and in compression if the slab expands. But failure in tension is much more common, experience shows. Flexural or transverse strength is also important in setting the depth of slab necessary for the traffic load. The usual formula is:

$$D=\sqrt{\frac{3W}{S}}$$

in which D is the required depth of slab in inches, W the maximum wheel load in pounds and S the allowable fiber stress in concrete.

Assuming W to be 9000 lb. we may calculate D for the two aggregates mentioned as tested in Tennessee with moduli of rupture of 763 and 629 lb. The values of S (one-half the modulus of rupture) would therefore be 382 and 315 lb. D for the first would therefore equal 8.4 in. and for the second 9.3 in. This is practically a difference of 1-in. in thickness.

Looking at the matter from another way, take the aggregates studied for the Mount Vernon highway. A study of their plot shows that for a water-cement ratio of 0.60 one aggregate will give a modulus of rupture of 500 lb., the other 650 lb., a 9000-lb. wheel load on a slab corner will set up a stress of about 330 lb., which is 66% of the modulus of rupture in one case and only 50% in the other. It is obvious that there will be a greater insurance against breakage with the second aggregate than with the first. These illustrations seem to justify a method of design which would tend to equalize differences in strength due to aggregate characteristics.

Durability

Durability, the resistance to weathering, is the most important single characteristic of paving concrete. We have no way, at present, of evaluating durability and the problem is further complicated by the fact that handling, curing, etc., affect durability to a

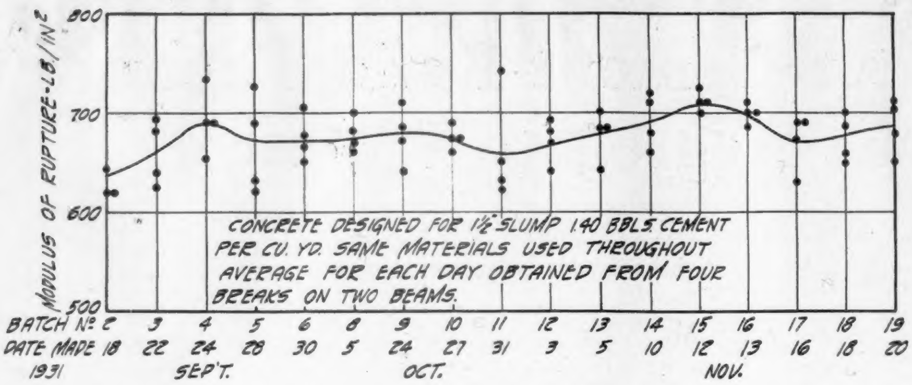


Fig. 3. Day-to-day variations in transverse tests of concrete

greater degree than they do strength. Hence design for durability should secure workable, plastic mixes that can be uniformly placed.

Aggregates play a double role in durability. They should be composed of sound, hard, durable particles themselves, and they should be so graded as to produce plastic, workable concrete with the quantity of cement to be used.

Observations of structures and freezing and thawing tests in the laboratory indicate that durability is largely a function of the water-cement ratio. This has led a committee of the Highway Research Board (of which Mr. Jackson is a member) to recommend a water-cement ratio of 0.8 (6 gal. per sack) as the lowest allowed in concrete exposed to weather, regardless of the strength obtained.

Mr. Jackson wanted it understood he was not interested in trial methods to save first cost by lowering the cement factor. The saving in cost is negligible as compared with the danger resulting from too lean concrete which is difficult to place properly. The important point is to insure that the strength of the concrete will be at least as high as that assumed in designing the slab, or that proper adjustment in the depth of the slab is made to compensate for variations in concrete strength.

Technique of the Water-Cement Ratio Trial Method

It goes without saying that work involving the comparison of materials should be very carefully done. Good laboratory practice should be followed, other variables than the one of which the effect is sought should be eliminated as far as possible, and tests should be repeated as often as may be necessary to secure reliable indications.

In many cases the method adopted in Tennessee may be followed. This consists in testing a standard mix with the others to compensate for differences in weather conditions, personal equation of operator, etc. The chart (Fig. 3) made from Tennessee data shows the day by day variation for a standard combination of materials over three months. The line shows the average of four breaks made on two beams and the dots show individual values. The range is from 635 lb., September 18, to 710 lb., November 12, a variation of 75 lb. in modulus of rupture. Leaving out the extremely high and low breaks the range is about 40 lb. The results on the high day (September 18) and the low days (November 12 and 13) were quite concordant, indicating some condition of temperature or curing may have been responsible.

Wisconsin tested a large number of combinations in 1930 and 1931 using four water-cement ratios, ranging from 0.6 to 0.1. A typical chart (Fig. 4) is shown. It shows that for this particular material a water-cement ratio of 0.67 is required for a flexural strength of 750 lb. in 28 days, corresponding to a cement factor of 5.5 bags. In some cases check tests were run at later periods. In spite of the fact that different cements were used and that the control of conditions was not all that it should be, reasonably close checks were obtained in all cases but one (H), as shown by the following table. The influence of the change in cement is clearly traced, showing that closer checks might have been expected if this variable had been eliminated.

Additional testimony of variations due to using different cements is found in the chart made from results obtained in Tennessee (Fig. 6). All other factors than the brand of cement were constant.

The statement has been made that variations in the portland cement used not only affect the actual strength of the concrete but markedly affect the relative strengths developed by different aggregates. Tests made to throw light on this, in the laboratory of the Bureau of Public Roads, are given in Table 2. The variation between aggregates No. 1 and No. 2 ranges from 0.18 to 0.33 indicating a considerably different behavior with cement D than with the others. However, there was a high break of 655 lb. which is out of line with the others and if this is eliminated the range is from 0.18 to 0.26.

The fact that Wisconsin uses local materials more than any other state makes a

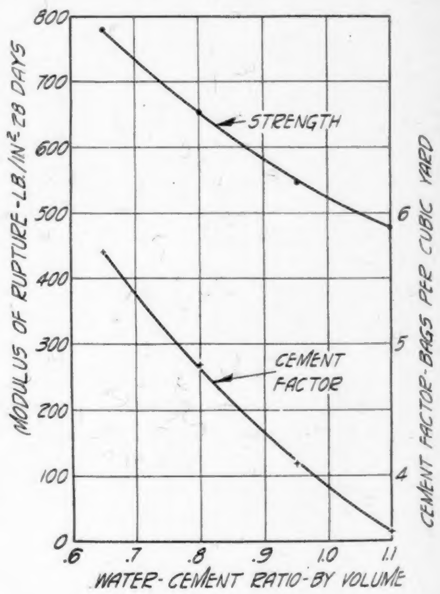


Fig. 4. Test results on materials from one source

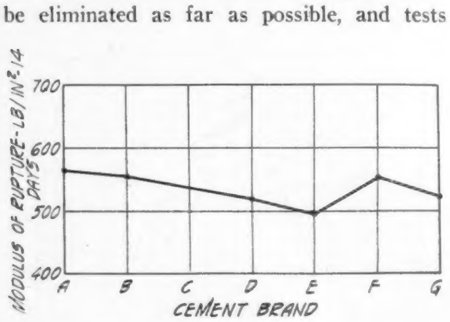


Fig. 5. Variations in transverse strength due to variations in quality of cement

Material combination	Date tested	Cement used—tensile strength at 28 days lb. per sq. in.	Cement factor Bags per cu. yd.	Difference
A	March, 1930	388	5.2	....
	June, 1931	428	4.9	0.3
B	May, 1931	428	4.5	....
	May, 1931	428	4.4	0.1
C	March, 1931	388	5.3	....
	July, 1931	428	4.9	....
	October, 1931	452	5.2	0.4
D	March, 1930	388	5.5	....
	October, 1930	452	5.3	0.2
E	May, 1931	428	5.6	....
	October, 1931	452	5.4	0.2
F	April, 1930	402	5.4	....
	October, 1931	452	5.5	0.1
G	January, 1931	410	4.4	....
	March, 1931	410	4.2	0.2
H	March, 1930	388	5.5	....
	July, 1931	428	4.7	0.8

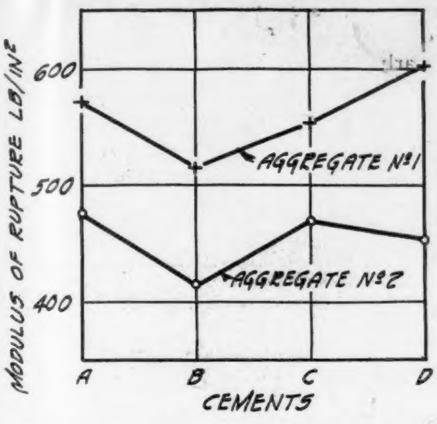


Fig. 6. Results of flexure tests using four cements and two aggregates

large number of tests necessary. Data from 56 local material combinations and from 35 commercial plant combinations (only the latter, Fig. 7, are reproduced here) have been plotted to show the range in water-cement ratio and cement factor for the 750 lb. modulus of rupture in 28 days. The variations are from 4 to 8 bags per cu. yd. for the local materials and 4.0 to 5.5 for the plant materials, a much lower range.

It is interesting to note that those (Wisconsin) materials that are essentially calcareous generally produce a given strength with a lower cement factor than those essentially igneous. This is further evidence of the fact that the character of the aggregate plays an important part in influencing the strength of the concrete. [Note: Most Wisconsin gravels are mainly of dolomite and hence are "essentially calcareous in their nature."—Editor.]

Practical Limitations

The greater the number of tests the more reliable is the average obtained from their results, but this may be carried to a point where the cost is out of proportion to the value received. Experience in the states using this design method has shown an average of four breaks for each test condition is sufficient to warrant classification based on a difference in cement factor of 0.2 sack. It is of interest in this connection to investigate the cement-water ratio (instead of the water-cement ratio). If this is essentially a straight line relation it might be possible to interpolate more accurately and cut down the number of tests.

Mr. Jackson recommended that this type of specification should be used only where the facilities for testing are of the best and where the organization is such that the specification can be effectively administered. In other cases he believes the most satisfactory specification to be one based on a constant cement factor for all types of material, because it is easy to administer and it insures a reasonably uniform yield.

[Paragraphs omitted from abstract here discuss the importance of taking the quality of aggregate into account drawing illustrations from the Bureau of Public Roads tests of 1931. See ROCK PRODUCTS, October 24, 1931, for a discussion of these.]

Economic Aspects of the Method

Assuming cement to be $0.40 a sack and sand and gravel to be $1.50 per ton, a differential of 0.2 sack cement would affect the cost of concrete about 10c per cu. yd. Against this is a small saving in aggregate required with the higher cement factor. In many cases the material calling for the higher cement factor will weigh less per ton, and this in some cases may wipe out the cost of the higher cement factor.

It seems no more than fair to give the higher strength aggregate the economic advantage. It is a factor over which the producer has no control and may be viewed in the same way as a lower specific gravity, except that it works in the opposite direction. On the basis of the costs given, with aggregates having a specific gravity of 2.64 the cost of a 5-sack mix would be $4.48 as against $4.81 for a 6-sack mix. But if the lower strength aggregate had a specific

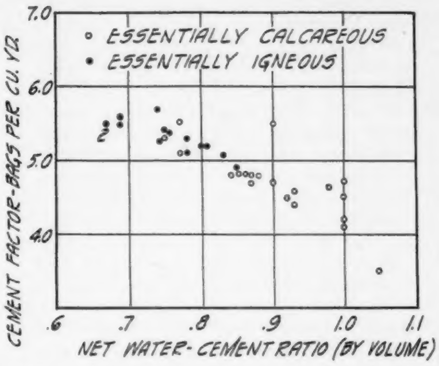


Fig. 7. Relation between cement factor and water-cement ratio

gravity of 2.50 the cost would be reduced from $4.81 to $4.68, lowering the differential from 33c to 20c.

These values illustrate some of the effect of variations in cement factor and specific gravity which will vary as the prices of materials vary. But comparisons based on 0.2 sack show how small would be the difference in cost resulting from the use of a minimum differential in cement. It was Mr. Jackson's opinion that a producer might build up a good will through prompt service, few or no rejections, and so more than balance the higher cement factor.

High Temperature Refractories

THE characteristics of some of the high temperature refractories are noted in an article in the February issue of *Chemical and Metallurgical Engineering.*

It is stated that pure thorium oxide has the highest melting point (3000 deg. C.), with magnesium oxide next (2800 deg. C.), but that both are quite sensitive to quick temperature changes. Pure beryllium oxide, with a melting temperature above 2500 deg. C., is little affected by temperature changes. Pure alumina has great stability and strength. Spinel, $MgO \cdot Al_2O_3$, has a higher melting point than alumina, but is not as hard. Zirconium oxide and zirconium silicate have lower melting points below (2000 deg. C.), the former being very sensitive to quick temperature changes and the latter very resistant to such changes. An experimental furnace in which temperature up to 2000 deg. C. were readily obtained, is mentioned.

Transactions of the National Safety Council

THE TRANSACTIONS of the 20th annual Safety Congress of the National Safety Council have been published. They cover the meeting that was held in Chicago, October 12-16, 1931. A separate volume covering the quarry section has been issued. Volume III of the Transactions, containing reports on street and highway, traffic, traffic schools, etc., and Statistical sections, were also published separately.

Estimate of 1931 Mineral Production of Canada

OWING to the drastic reduction in metal prices and on account of a lessened demand for nonmetallic minerals and structural materials, the total value of the mineral production of Canada in 1931 amounted to $227,-769,000, as against $279,873,578 in 1930, according to a report just issued by the Dominion Bureau of Statistics.

Nonmetallics, including asbestos, gypsum, salt, feldspar, magnesite, sodium sulphate and many minor minerals, were valued at $10,958,000, as compared with $15,217,864 in 1930. Structural materials such as cement, lime, stone, sand and gravel, and the various clay products, totaled $44,849,000, a decrease of 16.5% from the preceding 12 months.

ESTIMATE OF NONMETALLIC MINERAL PRODUCTION OF CANADA, 1931

		Quantity—1930	—Value	Quantity—1931	—Value
Asbestos	tons	242,114	8,390,163	162,278	4,611,000
Feldspar	tons	26,796	268,469	14,808	137,000
Gypsum	tons	1,070,968	2,818,788	842,192	2,018,000
Quartz	tons	226,200	418,127	140,788	282,000
Salt	tons	271,695	1,694,631	285,170	2,315,000
Talc and soapstone		....	186,216	....	165,000
Other nonmetals		....	1,441,470	....	1,430,000
		....	15,217,864	....	10,958,000
Cement	bbl.	11,032,538	17,713,067	10,017,331	15,722,000
Lime	tons	490,802	4,038,698	373,812	3,031,000
Stone, and sand and gravel		....	21,382,122	....	17,470,000

Temperature Measurements of a Rotary Kiln Shell and Calculations of Heat Losses

By T. Yoshii
Chichibu Cement Co., Ltd., Saitama, Japan

ALTHOUGH the rotary kiln has been used for many years and numerous improvements have been made to it, in calculating its heat balance various authorities frequently ignore many important facts and conditions. Therefore, it was decided by the author to actually measure the kiln shell temperatures by various methods and actually calculate the convection and radiation heat losses as an aid in arriving at the so-called ideal kiln.

Editors' Note

WE think this is an interesting and valuable contribution to the literature of portland cement manufacture, not so much for the results obtained, as because it illustrates the exercise of a natural curiosity that every cement operator should have regarding the efficiency of his plant operations.

The author has undoubtedly derived much personal satisfaction from his researches and in the results. But he also has accomplished a great deal more, and has undoubtedly added to his value in the organization by the intimate knowledge he has thus gained of that most important part of cement manufacture—the burning or calcining of the raw materials.

We hope others in the cement industry, in the United States as well as in Japan, will show a like curiosity and inquiring mind toward their every-day jobs. For there is joy in such work and there is much to be learned. If a cement mill operator's job is routine and uninteresting, it is because he makes it so.—The Editors.

Methods of Temperature Measurements

The temperature of a kiln shell may be measured by several methods, but it is very difficult to determine its true temperature. Richard K. Meade, in his book, "Portland Cement," proposed a method in which thermometers are inserted into steel wells or thimbles welded to the kiln shell. Others have used a surface pyrometer or electric wire wound around the shell, the temperature of the shell being determined by the electrical resistance of the wire. The author at first followed Meade's method as illustrated in Fig. 1. Steel pipes ⅝-in. in diameter were welded on the shell every 10 ft. and thermometers inserted in these. The thermometers, of course, revolved with the kiln shell. Temperatures were measured continuously for several months with the results shown in Table I.

Though the temperature of the kiln shell changes more or less with the atmospheric temperature, even in the comparatively hot season of the year (May, June and July), the mean temperature of the kiln shell was only between 140 deg. and 150 deg. C., as shown in Table I. This led me to doubt whether the kiln shell temperatures obtained by such a process are correct, so I especially observed the thermometer reading at point 15 (Table I). This thermometer was insulated in the steel well with asbestos and insulating mortar in so far as possible, and this resulted in a rise in temperature readings of about 10 deg. C.

From these observations I concluded that the reading of a thermometer merely inserted in the steel well is considerably below the actual temperature of the kiln shell, and also that it is almost impossible to obtain the true temperatures of the kiln shell with thermometers or surface pyrometers either. There is some decrease in temperature between the kiln shell and thermometer bulb, owing to the very thin air film existing between them.

Hence I contrived a method of measuring the kiln shell temperatures by measuring the elongation of the kiln in service, viz., when the kiln stopped for a considerable time and its shell had completely cooled, I marked a point perpendicularly below the end of the shell at each end of the kiln, and after the kiln had been started again and had attained a normal operating condition, I again measured the length of the shell between perpendiculars, determining its elongation compared to its original length several times and thus obtained the mean value of elongation, the results of which are shown in Fig. 2.

The room and kiln shell temperature (t) is taken at 13.5 deg. C. at the beginning of the operation, and as the kiln shell was made of mild steel, the coefficient of linear expansion is 0.0000117 per 1 deg. C. Then if the kiln length in feet is L when the kiln is cold, and the ultimate mean temperature of the kiln, after a constant operating temperature is reached, is T, the elongation of the kiln shell is l, according to the following formula:

$$l = 0.0000117 \times L \times (T - t)$$

$$0.38 \text{ ft.} = 0.0000117 \times 159.05 \text{ ft.} \times (T - 13.5)$$

Therefore $T = 217.7$ deg. C.

The atmospheric temperature when measuring the elongation was 5 deg. C. If the mean temperature outside all the year be taken at 15 deg. C., then the mean temperature of the kiln shell is assumed to be 222.7 deg. C. at 15 deg. C. outside temperature.

Therefore, the mean shell temperature of

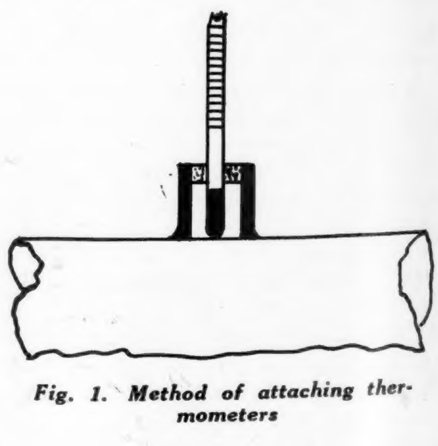


Fig. 1. Method of attaching thermometers

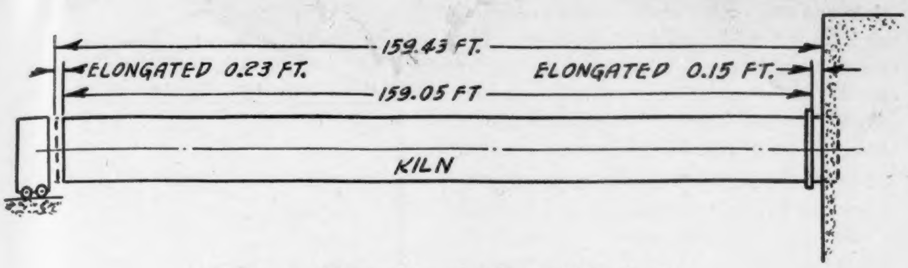


Fig. 2. Elongation of kiln shell by heat

144.29 deg. C., shown in Table I, is very low and only 64.76% of 222.7 deg. C. However, though the absolute values of the temperatures shown in Table I are too low, these temperatures are proportional to the true temperatures of the shell at these points.

So by multiplying the temperatures of the respective parts of the shell by the factor (F),

$$F = \frac{\text{mean shell temperature by thermal expansion}}{\text{mean temperature obtained by thermometers}} = \frac{222.7}{144.3} = 1.5433,$$

we can obtain the approximate true temperatures of the respective parts of the kiln shell. These results are shown in Table II and in the chart (Fig. 3).

Checking Method of Calculating Kiln Shell Temperatures

Although the temperatures of the kiln shell surface obtained by the thermal expansion method should be correct, I developed still another method to check these results. For this I used several substances whose melting or ignition points are known and easily determined, thus forming a series, or scale, for measuring comparatively low temperatures exactly as the Seger cone is used for measuring very high temperatures.

For example, if we want to measure any surface temperature, we place several substances from the scale on the cooled surface to be measured, and then a rough approximation of the temperature range of this surface can be obtained by knowing the ignition or melting points of the substances from which our temperature scale is formed. By using both this scale and a thermometer at the same time, we can determine the relation between their temperature indications or the correction factor (as F in the preceding paragraph). By a proper selection of the substances for our temperature scale we can determine surface temperatures quite accurately.

The temperature scales used for this purpose may be any of a number of elements and compounds, but especially useful are the fusible alloys consisting of lead, tin, bismuth an cadmium mixed in various proportions, or the use of paints that change color at definite temperatures, such as mercuric iodide (HgI_2), which is a scarlet powder at ordinary room temperature but changes to yellow at 150 deg. C. Such devices are very convenient because they may be used for the determination of surface temperatures of stoves, furnaces, electric motors, generators, etc.

Calculation of Heat Losses

Applying the Stefan and Boltzman's law to the kiln shell temperatures obtained as above, the radiation loss was calculated as shown in what follows.

Calculations hitherto made, using Stefan and Boltzman's law, were frequently carelessly done, and there is a very wide difference in the published results.

W. Gilbert's calculations were made by the following formula (See *Cement and Cement Manufacture,* Vol. III, No. 6, 1931):

$$Q_r = \frac{1.60\,(T_1^4 - T_2^4)}{10^9} \quad \ldots\ldots\ldots \quad (1)$$

Q_r = Radiation heat loss in B.t.u./ft.²/hr.

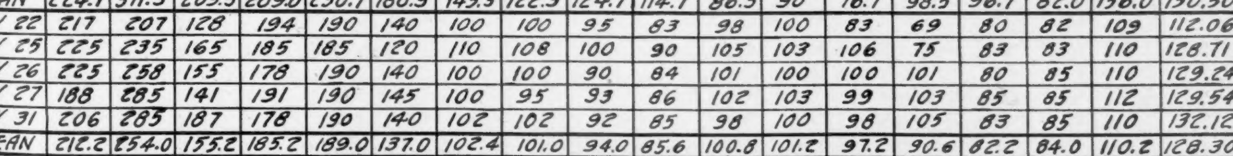
T_1 = Absolute temperature (F. deg.) of the kiln shell surface.

T_2 = Absolute temperature (F. deg.) of the atmosphere.

(e.g. 460 deg. + 60 deg. = 520 deg. F. absolute.)

It is not explained how the factor 1.60 is obtained, but it is evidently the radiation coefficient of the kiln shell.

In this formula the radiation coefficient of the kiln shell is considered, but the radiation coefficient of the heat absorbing medium which surrounds the shell is not considered.



DATE	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	P-13	P-14	P-15	P-16	P-17	MEAN	ATMOS. TEMP.
MAY 8	223°C	247	206	198	230	190	145	125	125	114	85	90	76	96	95	85	155	146.18	14.1
MAY 9	231	314	209	222	232	181	148	122	124	116	88	91	79	101.5	98	81	158	152.70	16.8
MAY 10	220	373	214	230	230	170	140	120	125	114	86	89	75	98	97	80	155	152.47	13.5
MEAN	224.7	311.3	209.3	209.0	230.7	180.3	143.3	122.3	124.7	114.7	86.3	90	76.7	98.5	96.7	82.0	156.0	150.50	14.8
MAY 22	217	207	128	194	190	140	100	100	95	83	98	100	83	69	80	82	109	112.06	19.1
MAY 25	225	235	165	185	185	120	110	108	100	90	105	103	106	75	83	83	110	128.71	20.4
MAY 26	225	258	155	178	190	140	100	100	90	84	101	100	100	101	80	85	110	129.24	22.0
MAY 27	188	285	141	191	190	145	100	95	93	86	102	103	99	103	85	85	112	129.54	22.0
MAY 31	206	285	187	178	190	140	102	102	92	85	98	100	98	105	83	85	110	132.12	23.8
MEAN	212.2	254.0	155.2	185.2	189.0	137.0	102.4	101.0	94.0	85.6	100.8	101.2	97.2	90.6	82.2	84.0	110.2	128.30	21.5
JUNE 12	212	258	185	156	190	190	110	125	105	110	110	96	95	91	90	90	130	137.82	21.1
JUNE 16	231	220	210	150	190	180	110	130	110	113	110	110	103	110	95	90	130	140.10	20.6
JUNE 18	232	274	197	162	190	180	115	130	110	110	112	113	103	91	90	96	135	143.53	18.3
JUNE 28	244	291	209	140	185	180	109	136	108	113	113	110	95	99	96	94	126	144.00	23.1
MEAN	229.8	260.8	200.3	152.0	188.8	182.5	111.0	130.3	107.3	111.5	111.3	107.3	99.0	97.8	92.8	92.5	130.3	141.40	20.8
JULY 24	245	255	240	165	160	215	130	150	125	123	118	109	109	109	110	102	150	153.82	31.6
JULY 25	218	290	200	207	190	225	128	155	135	134	128	112	114	115	108	108	155	160.12	30.4
JULY 26	260	270	200	167	170	157	134	150	132	130	130	108	107	115	115	107	155	153.35	26.7
JULY 27	250	267	210	202	235	165	135	155	132	130	130	113	118	116	115	108	150	160.65	29.3
MEAN	243.3	270.5	212.5	185.3	188.8	190.5	131.8	152.5	131.0	129.3	126.5	110.5	112.0	113.8	112.0	106.3	152.5	157.00	29.5
TOTAL MEAN	227.5	274.2	194.3	182.9	179.3	172.6	122.1	126.5	114.2	110.3	106.2	102.2	96.2	100.2	95.9	91.2	137.3	144.30	22.1

Table I. Rotary kiln shell temperatures by thermometer

The lower half surface of a rotary kiln, of course, faces the ground or floor, and the upper half the inside of the roof or open air, if there is no roof covering. Therefore, we must consider the radiation coefficient of the heat absorbing medium as well as the coefficient of the kiln shell. Otherwise, according to the formula used by Gilbert, the radiation loss would always be the same whether or not the kiln was covered with a roof or exposed to the weather, which is not the case.

Many calculations of radiation loss that I have seen have some defects, an extreme case being the total neglect of the law of heat exchange relating to radiation, or the considering of atmospheric temperatures as absolute temperatures. These calculations naturally I did not accept.

In my calculation I first used Nusselt's formula:

$$\frac{Q}{\theta} = \frac{(A)\left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right]}{\frac{1}{e_1} + \frac{1}{e_2} - \frac{1}{E}} \quad \ldots\ldots (2)$$

$\frac{Q}{\theta}$ = Heat quantity lost from the high temperature body in unit time.

A = Surface area.

$e_1\, e_2$ = Radiation coefficients of the two bodies respectively.

T_1, T_2 = Surface temperatures of the two bodies respectively (absolute temperature).

E = radiation coefficient of the perfect black body.

Then under the guidance of Dr. M. Kinoshita, professor at Tokyo Technical College, I used his formula (3). The results are almost identical with Nusselt's formula, and it is much more convenient to use. Dr. Kinoshita's formula is as follows:

$$\frac{Q}{\theta} = \frac{(A)\, e_1, e_2}{E}\left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right] \ldots (3)$$

The symbols are the same in both formulas. A is the surface area of the kiln shell.

e_1 is the radiating power or coefficient of the kiln shell if its relative degree of blackness be taken at 0.90.

$e_1 = E \times 0.90 = 0.162 \times 0.90 = 0.1458$.

e_2', e_2'' are the radiation coefficients of the earth's surface (e_2') and inside of the roofing (e_2''). In this case the roof of the kiln room was dull zinc roofing and its relative degree of blackness can be taken as 0.22.

$e_2' = E \times 0.22 = 0.162 \times 0.22 = 0.03564$.

Though the earth's surface by its soil character may be different more or less, if its degree of radiation absorption be taken at 0.40 then $e_2'' = E \times 0.40 = 0.162 \times 0.40 = 0.0648$.

If there is no roof, the kiln shell is open to the atmosphere and degree of blackness of the sky may be taken as 1.0.

In the case under consideration there were two kilns of the same size parallel to each other and the center angle at the center of one kiln section, included by the other kiln's diameter, is almost 24 deg., and the angles at every point on the center line of one kiln included by the length of the other kiln is almost 132 deg. and 30 min. on an average.

The temperatures of the respective parts of the kiln having the same size are assumed to be equal to each other. Then it is rational to omit the area A' (where the two shell surfaces face each other) from the shell surface area out of which the radiation loss calculation is made.

$$A' = A \times \frac{24 \text{ deg.}}{360 \text{ deg.}} \times \frac{132.5 \text{ deg.}}{180 \text{ deg.}}$$

Of the remaining kiln shell surface almost one-third of the total area faces the ground and two-thirds the roof. Therefore, divide the kiln shell surface A ($A = 10.12$ ft. [outside diameter] $\times \pi \times$ [159.05 + 0.38] = 5066.7 sq. ft.), into three parts in the proportion above mentioned, which results in the following:

$$5066.7 \times \frac{24}{360} \times \frac{132.5}{180}$$

= 248.6 sq. ft.........to be omitted
= 3212.1 sq. ft.........facing the roofing
= 1606.0 sq. ft.........facing the ground

Then the radiation losses of the respective parts of the shell may be calculated as follows:

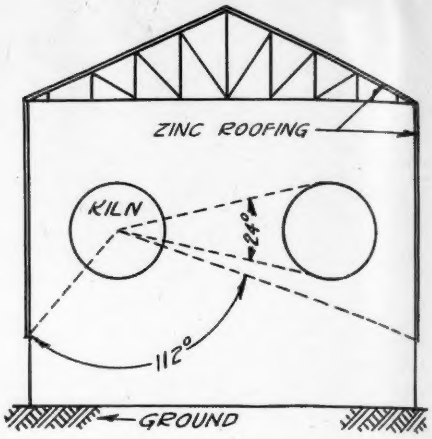


Fig. 4. Section of kiln room

For the portion of the kiln facing the ground the loss of heat is

$$\frac{Q}{\theta} = \frac{0.1458 \times 0.0648}{0.162}\left[7491.9 - 723.3\right] \times 1606$$
$$= 633{,}960 \text{ B.t.u. per hr.}$$

And the total heat lost is

697,379 + 633,960 = 1,331,339 B.t.u. per hr.

The output of the kiln at the time was about 62 bbl. per hr., and the required heat in B.t.u.'s per bbl. was 320,000 Kcal = 320,000 × 3.968 = 1,269,760 B.t.u.

Hence the percentage of heat loss from

TABLE II. CALCULATION OF ABSOLUTE SHELL TEMPERATURES

Position	Shell temps. by thermometer Deg. C.		Factor (F.)		Real temps. of the shell Deg. C.	T_1 (Absolute deg. F.)	$\left(\frac{T_1}{100}\right)^4$	
1	227.5	×	1.5433	=	351.1	632.0 + 491.6 = 1123.6	4 × log 11.236	15938
2	274.2	×	1.5433	=	423.2	761.8 + 491.6 = 1253.4	4 × log 12.534	24681
3	194.3	×	1.5433	=	299.8	539.6 + 491.6 = 1031.2	4 × log 10.312	11308
4	182.9	×	1.5433	=	282.3	508.1 + 491.6 = 999.7	4 × log 9.997	9988
5	199.3	×	1.5433	=	307.6	553.7 + 491.6 = 1045.3	4 × log 10.453	11939
6	172.6	×	1.5433	=	266.4	479.5 + 491.6 = 971.1	4 × log 9.711	8892.8
7	122.1	×	1.5433	=	188.4	339.1 + 491.6 = 830.7	4 × log 8.307	4761.7
8	126.5	×	1.5433	=	195.2	351.4 + 491.6 = 843.0	4 × log 8.430	5050.3
9	114.3	×	1.5433	=	176.4	317.5 + 491.6 = 809.1	4 × log 8.091	4285.5
10	110.3	×	1.5433	=	170.2	306.4 + 491.6 = 798.0	4 × log 7.980	4055.1
11	106.2	×	1.5433	=	163.9	295.0 + 491.6 = 786.6	4 × log 7.866	3828.3
12	102.2	×	1.5433	=	157.7	283.9 + 491.6 = 775.5	4 × log 7.755	3616.8
13	96.2	×	1.5433	=	148.5	267.3 + 491.6 = 758.9	4 × log 7.589	3316.8
14	100.2	×	1.5433	=	154.6	278.3 + 491.6 = 769.9	4 × log 7.699	3513.3
15	95.9	×	1.5433	=	148.0	266.4 + 491.6 = 758.0	4 × log 7.580	3301.2
16	91.2	×	1.5433	=	140.7	253.3 + 491.6 = 744.9	4 × log 7.449	3079.0
17	137.3	×	1.5433	=	211.9	381.4 + 491.6 = 873.0	4 × log 8.730	5808.1

Corresponding to shell temperature 243.8 deg. C. ← 7491.9 mean.

$\left(\frac{T_2}{100}\right)^4$: $T_2 = 59 + 459.6 \quad \left(\frac{T_2}{100}\right)^4 = \left(\frac{518.6}{100}\right)^4 \rightarrow 4 \log 5.186 \rightarrow 723.3$

Applying the foregoing results to the formula (3), the loss of heat from the portion of the kiln facing the roof is

$$\frac{Q}{\theta} = \frac{0.1458 \times 0.03564}{0.162}\left[7491.9 - 723.3\right] \times 3212.1$$
$$= 697{,}379 \text{ B.t.u. per hr.}$$

radiation per barrel of cement per hour is

$$\frac{1{,}331{,}339 \times 100}{1{,}269{,}760 \times 62} = 1.69\%$$

Or at least 1.69% of the coal burned was loss through radiation from the kiln shell.

TABLE III. CALCULATION OF THE CONVECTION HEAT LOSS

Position	Temperatures of the shell Deg. C.	Deg. F.	Atmospheric temperature Deg. F.	$\triangle t^{1.25}$		
1	351.1 =	664.0	59	$605.0^{1.25}$	1.25 log 605.0	3000.5
2	423.3	793.8		$734.8^{1.25}$	1.25 log 734.8	3825.7
3	299.8	571.6		$512.6^{1.25}$	1.25 log 512.6	2439.2
4	282.3	540.1		$481.1^{1.25}$	1.25 log 481.1	2253.2
5	307.6	585.7		$526.7^{1.25}$	1.25 log 526.7	2523.2
6	266.4	511.5		$452.5^{1.25}$	1.25 log 452.5	2087.0
7	188.4	371.1		$312.1^{1.25}$	1.25 log 312.1	1311.8
8	195.2	383.4		$324.4^{1.25}$	1.25 log 324.4	1337.7
9	176.4	349.5		$290.5^{1.25}$	1.25 log 290.5	1199.3
10	170.2	338.4		$279.4^{1.25}$	1.25 log 279.4	1142.3
11	163.9	327.0		$268.0^{1.25}$	1.25 log 268.0	1084.3
12	157.7	315.9		$256.9^{1.25}$	1.25 log 256.9	1028.5
13	148.5	299.3		$240.3^{1.25}$	1.25 log 240.3	946.1
14	154.6	310.3		$251.3^{1.25}$	1.25 log 251.3	1000.6
15	148.0	298.4		$239.4^{1.25}$	1.25 log 239.4	941.7
16	140.7	285.3		$226.3^{1.25}$	1.25 log 226.3	877.7
17	211.9	413.4		$354.4^{1.25}$	1.25 log 354.4	1537.7

Mean 1678.6 corresponds to $\triangle t = 380.2$ deg. F. shell temperature = 226.2 deg. C.

Heat Lost by Convection

Applying Langmuir's formula for calculating the loss of heat by convection:

$$\frac{Q}{\theta} = h_G A \triangle t \text{ where } h_G = 0.28\ (\triangle t)^{0.25}$$

$$\frac{Q}{\theta} = 0.28\ (\triangle t)^{0.25} A \triangle t$$

$$= 0.28\ (\triangle t)^{1.25} A \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Note:

$\frac{Q}{\theta}$ = the quantity of heat lost in a unit of time (B.t.u.).

A = Surface area of the kiln shell (sq. ft.).

Δt = Temperature difference (in deg. F.) between the kiln shell surface and the surrounding atmosphere.

Formula (4) is that for application to vertical surfaces. For the upper side of a horizontal surface the convection loss is increased 10%; and for the lower side of a horizontal surface it is decreased 50%. Taking a mean value, in the case of a kiln shell, the loss becomes 90% of that of a vertical surface. Substituting these values in the formula (4):

$$\frac{Q}{\theta} = 0.28 \times 1678.6 \times 0.9 \times 5066.7$$

$$= 2{,}143{,}251 \text{ B.t.u. per hr.}$$

Hence the convection loss of heat per barrel of cement is

$$\frac{2{,}143{,}251 \times 100}{78{,}725{,}120} = 2.72\%$$

Therefore the total percentage of heat losses by both radiation and convection is $2.72 + 1.69 = 4.41\%$.

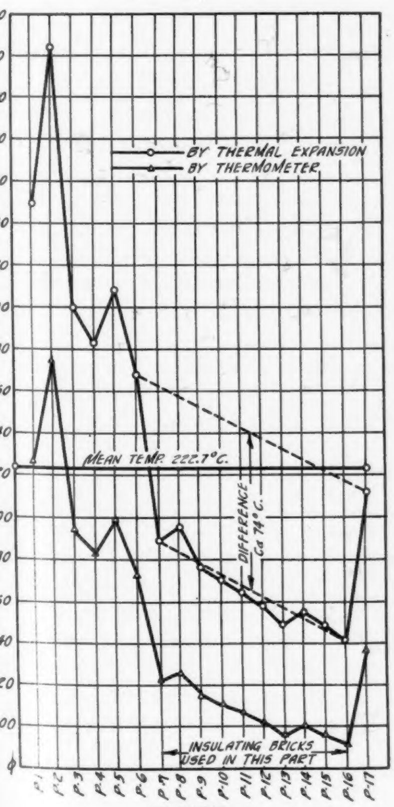


Fig. 3. **Kiln shell temperatures**

Diagram

The radiation and convection losses corresponding to every kiln shell temperature were calculated and plotted in Fig. 5, assuming that in the radiation from the kiln shell a half surface is directed toward the sky, or the roof, and the other half toward the ground; and that there is no wind or current of air.

Hood Losses

The outside of the kiln hood is made of steel plate and brick work, and calculation of its heat loss may be made in the same manner as for the kiln shell. On this basis the total heat loss is calculated to be 140,770 B.t.u. per hr. or 0.18% of the total heat or fuel required.

Effect of Wind and Revolution of Kiln Shell

The rotary kiln revolves very slowly, that is to say, 1 to ⅓ revolutions per minute, so that the loss of heat due to the circulation of air caused by its rotation is negligible.

The influence of the wind on the loss of heat from the kiln shell was discussed by W. Gilbert in *Cement and Cement Manufacture*, Vol. III, No. 9, 1930, concisely, and according to him the wind influence in this case is also negligible.

There are miscellaneous plus and minus items affecting heat loss from the kiln shell, such as the influence of cohesive clinker dust on the exterior of the shell surface, the effect of riveted and butt joints in the shell, and the effect of the change in atmospheric pressure, humidity of the air, etc. However, it is difficult to consider all these factors in the calculation of the kiln shell heat losses, and these effects are relatively insignificant, so I have neglected them and assumed that these factors offset one another.

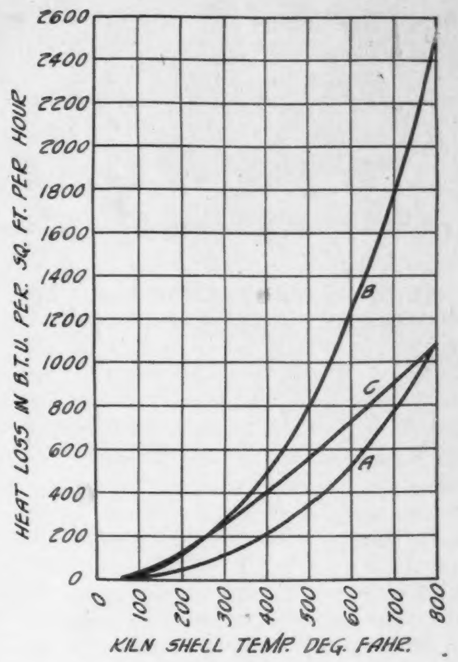


Fig. 5. **Radiation and convection losses**

As shown in Fig. 3, the temperatures of that part of the kiln shell where insulating bricks are used between the fire brick and the shell are lower by about 74 deg. C., as a mean, than the temperatures of the adjoining parts where there are no heat insulating brick. I suggest to some of the readers of this article that they try to calculate how much heat is saved by the use of these insulating brick.

Conclusions

I have used an original method to measure the temperature of the rotary kiln shell and calculated the radiation and convection heat losses, considering the various conditions of the kiln in detail. I have thus found that the heat loss is unexpectedly small in a well designed rotary kiln of today. On the other hand, I believe Dr. Martin's opinion as expressed in his article, "Researches on the Rotary Kiln in Cement Manufacture," Part 21, in Rock Products, June 20, 1931, "The apparent external radiation loss of heat is only about 5½%, but the real effective loss, is nearer 15%," is theoretically correct.

The heat loss from rotary cement kilns can be lessened or prevented by painting the surface with substances which have small radiation coefficients, by not exposing the shell to the weather, by using insulating materials inside the shell, by avoiding irrational burning of coal, etc.

The heat loss of the cooler shell can be calculated in the same way.

Hints and Helps for Superintendents

Improvised Slackline Used on Small Excavation Project

By W. J. Beatty
Castroville, Calif.

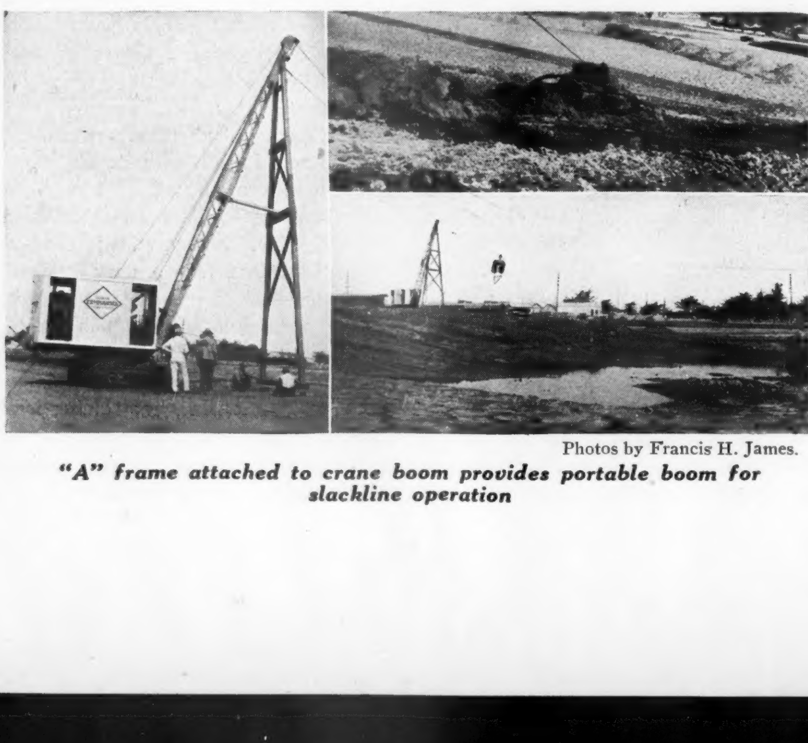
AN UNUSUAL ADAPTATION of standard excavating equipment is in progress at Monterey, Calif., where an old marsh which could be seen by all who entered Monterey by train or motor is being converted into El Estero park.

A plan to reduce the water area, which in the rainy season and during high tide covered 30 acres, to 18 acres with a normal depth of 5 ft., leaving an island or two for better appearance was adopted.

It is estimated that an excess of 80,000 cu. yd. of material must be moved from about the center of the marsh to the banks, to form an irregular shore line. The maximum distance the material must be moved is 300 ft. and the normal depth of 5 ft. must not be exceeded. Sand and blue clay intermixed with decayed vegetable matter comprise the material to be moved. In some spots the material is compacted and very difficult to dig, causing the scraper bucket to ride over the area being scraped. Teeth were bolted to the lip of the scraper which partially corrected the slipping and sliding of the bucket.

The scraper bucket being used was built by the contractor and has a capacity of 67 cu. ft. It is hauled in fully loaded at a speed of 180 ft. per min., and returned by gravity a distance of 250 ft. in 12 sec. An Osgood "Commander" with a 50-ft. boom is being used, with the boom supported by an "A" frame attached to the boom points. In moving laterally, the Osgood operator releases the slackline and lifts the boom, then moves in the direction desired and sets the boom down on the frame again. Satisfactory anchorage is afforded by trees on the opposite bank. The slackline is a ¾-in. cable.

Yardage moved to date has varied according to the distance hauled. Where the average haul has been 180 ft. and the material loose, the system has moved 800 cu. yd. into place in an eight hour day. The operator has been able to finish the shore to a satisfactory grade by manipulation of the slackline as the load is being hauled in.



Photos by Francis H. James.

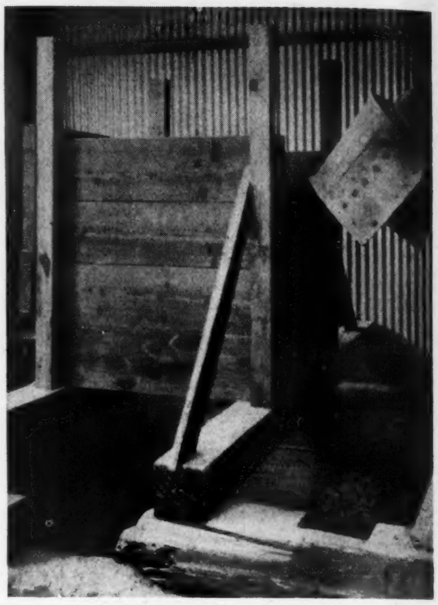
"A" frame attached to crane boom provides portable boom for slackline operation

Eliminating Wear on Bin Walls

WHERE MATERIAL is carried from the sizing screen to bins through a long chute, it will necessarily fly across the bin and strike the far side unless deflected downward. Where the material is not particularly abrasive a deflecting shield can be put upon the end of the chute with little trouble, but with oversize stone this may not be so satisfactory.

At the plant of the Francey Stone and Supply Co., Wauwatosa, Wis., the heavy stone wore away several inches of the concrete side of the bin within a very short time and it was necessary to find some method of deflecting the material.

The method used was to let the stone wear upon itself. A heavy three-sided plank box was built upon a pair of heavy beams which rested on the edges of the bin. The box was set to receive the discharge at its center. It was at once partially filled with stone, and after that stone falling into it merely rolled off, damaging neither the box nor the sides of the bin, since the stone already in the box received the wear. The lowest plank on the far side of the box was removed to allow a small amount of the stone to pass out in that direction and thus keep the level of stone in the box lower.



Stops wear on bin walls

Preventing the Rusting of Exposed Screw Threads

By W. E. Warner
Welwyn Garden City, Herts, England

WHERE THREADED CONNECTIONS are exposed to the weather, rusting and corrosion will take place, making it difficult and in many cases impossible to get the connection apart without ruining it. Ordinary lubricant has little effect in preventing this, as it is soon gone. A much thicker graphite lubricant, which I have found very satisfactory for this purpose, is made as follows:

Melt equal parts of tallow and white lead together in an iron kettle and then stir in about 5% of flake graphite. The three ingredients should be thoroughly mixed together. Then stop heating and add mineral oil in the amount of about one-third by volume of the original mixture, continuing the stirring until cold. The mixture will then have the consistency of a thick paste.

This should be applied to the threads of any screwed connection when it is made up and will prevent rusting and corrosion even though exposed for several years. It can also be used as a heavy lubricant, as besides being a good lubricant it has the quality of adhering to the surfaces. The white lead prevents the formation of any corrosive acids.

Rock Dust in Crushing Plants

EVEN THE MODERN and up-to-date crushing plants equipped with dust collectors have troubles with dust collecting and accumulating in certain unexpected spots to such an extent that it must be removed at regular intervals. For example, the under side of conveyor belts, the return or under side of elevators, leaky chutes, etc. This must be removed by clean-up men.

In a crushing plant crushing an extremely siliceous stone this condition exists. The dust adheres to the conveyor belt and is knocked off by the return idlers. Considerable dust is knocked off by the first idler, less by the second, and still less by the third. At about the fifth idler no dust is knocked off at all and the belt is clean.

Since this belt is 10 ft. or more above the floor at the lowest point, and with nothing to interfere, there is no reason whatsoever for this condition existing. However, as it now is, the dust falls down and accumulates to such an extent that an opening has been made so trucks can back in and the dust is loaded by hand into the truck.

There are many devices for cleaning off belts. One cleaning device could be contained in a small iron hopper and the dust collected could be discharged on to a very small enclosed conveyor to a bin outside the crushing plant, which could be emptied as often as necessary by gravity into a truck.

The owner of the plant referred to has spent many thousands of dollars to abate dust, and plans to correct this point in his plant this winter; but how many others have this same or worse condition and do nothing?

Rehandling Sand or Aggregate

WHERE sand or other material is transferred from trucks to batching bins by means of a crawler crane the following appears to be a cheap, unique and satisfactory system which could be used practically anywhere.

Dump trucks will not pile the material any higher than the lowest end of the dump body, and the tendency is to scatter the material over considerable territory and in a pile difficult to handle by a clamshell bucket. This causes waste of time and material as well as a certain amount of clean-up labor.

To overcome this one operator dug pits for the trucks to dump into. These pits have no drainage whatsoever, have no floor or side linings. Apparently in his case these items are not necessary.

Along the edge of the pits where the trucks dump, a 12x12-in. timber is anchored for the trucks to back into and be in the correct position to dump their loads and be away in a minimum amount of time. The size of the pit would of course determine how many trucks could dump, but it should be large enough to accommodate quite a few loads and deep enough and wide enough so that a large size clamshell bucket can operate without interference and always come up with a full load as long as there is any material in the pit.

If the pits are large enough to provide sufficient storage capacity, both crane and trucks can do almost twice as much work in a day than would be possible by dumping the material on the ground level and operating the bucket in a shallow, scattered pile. In addition it makes a much cleaner and neater job.

Bronze Weld for Concrete Pipe Reinforcement

THE OXY-ACETYLENE welding process has been used for some time in the manufacture of reinforcement forms for small and medium diameter concrete pipe, but it was only recently that it was introduced into the field of large diameter concrete pipe manufacture, a recent article in *Oxy-Acetylene Tips* states.

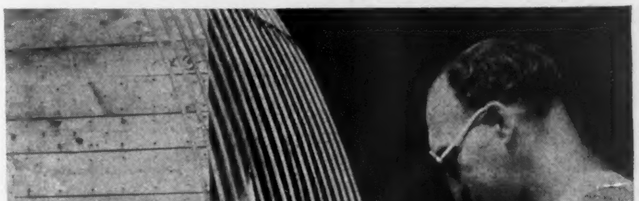
Concrete pipe forms had been made for years in a plant by methods that required high initial investments. Although the steel reinforcements were produced at a low cost, the joints were weak and did not hold together well. Many corrective plans had been tried, but all had proved unsatisfactory.

The oxy-acetylene process was first introduced in this plant as a maintenance unit.

A few experiments with oxy-acetylene blowpipe and high strength bronze welding rod convinced the superintendent that bronze-welding would accomplish what had been sought. The work was tried out in actual production with satisfactory results.

Consequently fabricating these steel forms by means of the blowpipe is now standard practice in this plant. In order to bronze-weld the pipe forms on an efficient production basis, suitable jigs were made so that the bars could be properly lined up parallel to each other and the proper distance apart. The bars are securely fastened in the jig, bent into circles, welded together, and removed to the yard where another welder attaches the struts that strengthen the forms.

This method of fabrication is reported as a success from many viewpoints. The initial investment for equipment was small, requiring only the purchase of suitable blowpipes for the work. The high-strength joints were obtained at no sacrifice of speed in production. Strength, economy and ease of joining were the paramount importance, of course, and were all efficiently accomplished by using bronze-welding as a means of joining the assembled concrete pipe reinforcement bars.



Suitable jigs facilitate production when using oxy-acetylene welding of reinforcing for concrete pipe

Rock Products Clinic

Bouquet for the Editor

THE EDITOR: We feel that we should inform you how much we appreciate your front page editorial in the February 13 issue of ROCK PRODUCTS.

We think it should stiffen up the backbone of the producers so that they will name a price for their product which fully covers cost of production and leaves a reasonable profit.

Your remarks about chiseling should also be well taken. It is inconceivable to think that the members of one industry can expect to stabilize the pricing of their own commodity if they resort to chiseling and induce members of another branch of industry to quote prices which do not afford them a profit.

We sincerely hope that your editorial will have wide publicity and be given very serious consideration.

Taking your advice will have only one result—improved conditions in general.

The Kent Sand and Gravel Co.
E. E. KLOOZ, President.
Youngstown, Ohio.

Not a Bouquet!

THE EDITOR: I take serious exception to the editorial, "Confidence," which appeared upon the front page of your issue of the 13th instant. You are evidently not informed as to the record of Herbert Hoover, or you have an axe to grind.

His record upon the surface is good and if delved into it is shameful. He has preached economy and practices waste. And he has done this for years. All who follow his moves closely know it.

Capital knows it, it knows that the net of his schemes and panaceas will be bankruptcy unless the government is operated upon a business basis. It knows that excessive taxation which results from government extravagance is dangerous and that is why it lacks the necessary confidence to go ahead.

This country and industry will not go ahead until there is visible evidence that waste has been controlled and that we are working toward economical and efficient government.

You can use your time to no better advantage than making a study of bureaucracy and its evils. I am certain that you have not, or you would never have written that editorial. If you will get into it, you won't go far before it will be evident there can be no durable prosperity until things change. Prosperity cannot exist in any country in which bureaucracy exists to the extent that it now does.

Bureaucracy exists in its present extensive state only because it is the only known way of maintaining a large controlled vote. There are 6,000,000 employes of the government who now can deliver an instructed vote. Each is estimated to control three votes through family, relatives, friends, etc. That makes 18,000,000 instructed votes. At the last national election there were cast 36,280,000 votes. That gives them an edge that it is unhealthy to allow them to have.

Total taxes amount to more than 30 c. per day per person—every man, woman and child in the country. The average family of five pays more than $500 per year taxes. They can't stand it. Yes, it was a good man who went along (in order to build his political fences) with a program that put us in that condition. And he is still doing it.

On the contrary, if taxation and waste are controlled before our resources are exhausted confidence will be restored and the road back will be easier than if it does not happen until we are broke. If you want prosperity that is the thing to work for. We can't have it until public opinion understands the situation and gets back of the necessary medicine.

L. D. STAPLIN,
Carbonite Metal Co., Ltd.,
Chicago, Ill.

High Early Strength Cements for Ready-Mix Concrete

THE EDITOR: Thank you for your note of recent data informing me of an item in ROCK PRODUCTS covering the question of the paper presented at the Ready-Mixed Concrete Association meeting. I believe that you have not quoted exactly my position in regard to high-early strengths cement. I stated as follows: "Present day cements frequently have excellent early strengths; but show retrogression with age. It can be safe to assume that it is advisable to look upon a cement with suspicion that shows retrogression in compressive tests and avoid its use."

In my comments I stated that I was giving in a table the data from tests of one brand of portland cement that showed retrogression and I could probably name at least five others that would show the same characteristics. I was referring throughout this to normal portland cements and not to normal high-early strength cements. My only reason for commenting on this is that it might be assumed that I was referring to high-early strength cements, which personally I find show more of this characteristic than the normal portland cement; but I was referring to normal portland cement.

MILES N. CLAIR,
The Thompson & Lichtner Co., Inc.,
Boston, Mass.

How Long Will the Bank Roll Last?

THE EDITOR: On September 17, 1931, at Cedar Rapids, Iowa, the county seat of Linn county, bids were received for crushed stone for road surfacing, the low bid on the different projects being as follows:

6300 cu. yd. complete on road, average haul 3¾ mi., per yd.	$1.09½
700 cu. yd. complete on road, average haul 4 mi., per yd.	1.25½
850 cu. yd. complete on road, average haul 7½ mi., per yd.	1.32½
8500 cu. yd. complete on road, average haul 6 mi., per yd.	1.13
200 cu. yd. loaded into county trucks at quarry, per yd.	1.03½
900 cu. yd. loaded into county trucks at quarry, per yd.	0.88½
400 cu. yd. rubblestone, county trucks at quarry, per yd.	0.48½

The bidding blanks stated:

1. County will furnish materials from quarry No. 58 or No. 59 as shown on accompanying map.

2. Specifications of Iowa Highway Commission series 1930 under section 405.9—Class "A" crushed stone will apply on materials secured from sources other than quarry No. 58 or No. 59. They will also apply on quarry No. 58 or No. 59 in every respect except that the wear clause is waived.

From the above you will see that the commercial quarries are penalized at the start in making up their bids, first by having to furnish their own stone, where the county provides the stone for the "road-sider" or portable plant. Second, the commercial plant must furnish stone that meets the specifications of the Iowa Highway Commission for the class of work bid. For the portable plant any stone will do, regardless of per cent. of wear, and in this case we know it is much softer than that from the commercial plants. If the stone from these two quarries did not have more per cent. of wear this clause would not be waived.

In addition it has always been the practice to have an inspector who is trained for this work, stationed at the commercial plants, to inspect and accept or reject all surfacing material for county work. His daily reports are sent to the engineer in charge each day. Quite often in the case of these "road-siders" there is no inspection by an official of the highway commission, while in this work the inspector will be a county truck driver or rodman who could say the wheels were turning or the truck was about full.

It would seem that the men who have invested their money in real commercial plants to produce specification materials at all times of the year are being discriminated against in favor of the man with a one-horse portable plant who only stays in the county long enough to complete his contract and then moves on to more green pastures.

The question is: Do the taxpayers get their money's worth by putting on an inferior material where the per cent. of wear clause is waived?

An Iowa Producer.

Editorial Comment

Victor Or Victim?

Let us present a hypothetical incident (but believe it or not, there is more truth than fiction in it): A large buyer of cement (or shall we say aggregates) advertises for bids. There is some apparent stability left in the industry and the bidders know about what price should be bid. Expectations are that all bidders are intelligent enough to know that the business will be let to some one, or split among several, at that price. The price, every one knows, is not even a return of costs, but at least it would mean stability.

One bidder thinks he is smarter than the others, and decides if he can cop all the order he can cut his costs below the others. He bids 15c less than the others who had the courage of their convictions. Of course, they sit by, after being double-crossed, and cheerfully see him get the order? No? Really! Why we thought that is what unsuccessful bidders always did.

No, indeed, children, sad and unorthodox as it may appear to your unsophisticated minds, the unsuccessful bidders did not retire to their corners to weep. As a matter of fact they raised Hell. They had all the bids thrown out, and offered new ones to meet the erring brother's low bid. But, the erring brother suspected their good intentions and put in a new bid for 15c below his first one. He'd be damned if he wouldn't get the business at any price. He did; for 30c less than he figured at first he could possibly produce it for.

Is he a victor or a victim?

Testing Concrete

To laymen, including most producers of aggregates, the important part of F. H. Jackson's National Sand and Gravel Association's paper on the water-cement ratio trial method of design is the exposition of the factors that affect the testing of concrete. Absolute checking on physical tests does not exist and never can, for reasons that are well understood. But present day variations are so within reason that the results from any good laboratory are accepted without question.

Mr. Jackson's paper shows that flexural strength tests of concrete may be affected as much as 11% by being tested at different *times* (the same materials mixed and cured in the same way on different days). As much as 15% variation may come from using a different brand of cement. The same aggregates behave differently with different brands of cement, so that the *relative* strengths of two aggregates are appreciably affected. But Mr. Jackson's charts do show positively that there is strength advantage in calcareous aggregates. With the work of Leavitt in mind one may wonder if this would be so apparent with all cements as it was in the Wisconsin tests that Mr. Jackson cites in his paper.

With such opportunities for variations in testing—variations which have nothing to do with the materials—one may ask if it is fair to select materials by laboratory tests. Mr. Jackson quite frankly says it is not unless the available testing equipment is of the best, the operators not only skillful but trained in the importance of even the minutest details, and the organization such that it can interpret the results of tests correctly and see that specifications based upon them are properly carried out.

Where equipment and trained men are not available, Mr. Jackson believes the best specification is one calling for a constant cement factor with all types of aggregates. Probably there are few engineers but will agree with him on this point. Having set the cement, the fine and coarse aggregates should be combined to produce the most workable and plastic mixtures of the desired consistency. There may be differences of opinion as to the best method of doing this, but experience has proved that combining to the right fineness modulus or proportioning according to the voids in the coarse aggregate, or according to some surface factor all give consistent results when used by engineers who know what they are doing. Even the now despised arbitrary proportion system makes good concrete in skillful hands—as it always has.

It should be remembered also that choosing materials by a laboratory test leaves out of account the availability of the material, the promptness with which it can be delivered, the assurance of its being uniform from the beginning to the end of the job, and certain other matters which Mr. Jackson points out may be far more important than the need for a little more cement as shown by a laboratory test. What is wanted of highway concrete—and all that is wanted—is a roadway of the requisite durability and strength at the least cost, and materials should be chosen with no other end in view.

Anti-Trust Law Revision

Sentiment in government circles is crystallizing in favor of some revision or temporary suspension of the anti-trust laws to permit industries to clean house, and legally establish price levels that will save them from bankruptcy. It is time every producer made up his mind as to what he wants. With legitimate price fixing would come more government supervision and regulation of business and industry. Profits in the future would be small, but possibly regular. The government once in would be hard to get out. It is a serious step. It concerns every one, both as a producer and as a consumer. Elsewhere in this issue is a discussion by a writer for the country's leading financial journal. It is interesting, helpful and thought provoking.

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

Stock	Date	Bid	Asked	Dividend
Allentown P. C. 1st 6's[27]	2-24-32	94	...	
Alpha P. C. new com.[2]	2-20-32	8	9	25c qu. Jan. 25
Alpha P. C. pfd.[2]	2-20-32	75	85	1.75 qu. Dec.15,'31
Amalgamated Phosphate Co. 6's, 1936[19]	2- 6-32	88	...	
American Aggregates com.[27]	2-25-32	2	4	
American Aggregates pfd.[27]	2-25-32	10	15	1.75 qu. Jan. 1
Amer. Aggr. 6's, w.w.[27]	2-25-32	38	50	
Amer. L. & S. 1st 7's[27]	2-24-32	70	75	
American Silica Corp. 6½'s[39]	2-24-32	No market		
Arundel Corp. new com.	2-24-32	23 actual sale		75c qu. Jan. 2
Bessemer L. & C. Class A	2-24-32	...	13½	
Bessemer L. & C. 1st 6½'s[4]	2-19-32	25	50	
Bloomington Limestone 6's[27]	2-24-32	...	25	
Boston S. & G. new com.[37]	2-19-32	4	6	15c qu. Jan. 2
Boston S. & G. new 7% pfd.[37]	2-19-32	30	35	87½c qu. Jan. 2
California Art Tile, A	2-19-32	1½	5¼	
California Art Tile, B[40]	2-18-32	...	3	
Calaveras Cement com.	2-19-32	1½	4	
Calaveras Cement 7% pfd.	2-19-32	...	60	1.75 qu. Jan. 15
Canada Cement com.	2-23-32	6¼	6⅝	
Canada Cement pfd.	2-23-32	63¾	64¾	1.62½ qu. Mar. 31
Canada Cement 5½'s[42]	2-18-32	88½	91	
Canada Crushed Stone bonds[42]	2-18-32	70	75	
Canada Crushed Stone com.[42]	2-18-32	5	...	
Certainteed Products com.	2-23-32	3⅛	3⅜	
Certainteed Products pfd.	2-23-32	11	20	1.75 qu. Jan. 1
Cleveland Quarries	2-24-32	...	54	25c qu. Mar. 1
Consol. Cement 1st 6½'s, A[44]	2-24-32	4	8	
Consol. Cement notes, 1941[27]	2-24-32	No market		
Consol. Cement pfd.[27]	2-24-32	...	50	
Consolidated Oka Sand and Gravel (Canada) 6½'s[12]	2-19-32	90	95	
Consolidated Oka Sand and Gravel (Canada) pfd.[41]	2-16-32	50	...	1.75 qu. Oct.10,'31
Consol. Rock Prod. com.[9]	2-18-32	25c	35c	
Consol. Rock Prod. pfd.[9]	2-18-32	2	2½	
Consol. Rock Prod. units[35]	2-18-32	1¼	1¾	
Consol. S & G. pfd. (Can.)	2-23-32	...	30	1.75 qu. Feb. 15
Construction Mat. com.	2-23-32	⅞	4	
Construction Mat. pfd.	2-23-32	4	7	
Consumers Rock and Gravel, 1st Mtg. 6's, 1948[35]	2- 4-32	38	42	
Coosa P. C. 1st 6's[23]	2-19-32	30	40	
Coplay Cem. Mfg. 1st 6's[33]	2-19-32	50	70	
Coplay Cem. Mfg. com.[33]	2- 5-32	5	7½	
Coplay Cem. Mfg. pfd.[23]	2- 5-32	25	40	
Dewey P. C. com.[47]	2-24-32	95	105	
Dolese and Shepard	2-23-32	18	20	$1 qu. Jan. 1
Dufferin Pav. & Cr. Stone pfd.[42]	2-18-32	...	45	1.75 qu. Jan. 2
Dufferin Pav. & Cr. Stone com.[42]	2-18-32	3	5	
Edison P. C. com.[32]	2-19-32	1½	...	
Edison P. C. pfd.[32]	2-19-32	5	...	
Federal P. C. 6½'s, 1941[19]	2- 6-32	72	...	
Giant P. C. com.[2]	2-20-32	1½	3½	
Giant P. C. pfd.[2]	2-20-32	8	12	1.75 s.-a. Dec. 15
Gyp. Lime & Alabastine, Ltd.	2-23-32	3⅝	3⅞	10c qu. Oct.5,'31
Gyp. Lime & Alabastine 5½'s[42]	2-18-32	59	63	
Hermitage Cement com.[11]	2-20-32	5	12	
Hermitage Cement pfd.[11]	2-20-32	32	36	
Ideal Cement, new com.	2-23-32	19	22	50c qu. Jan. 2 & 25c ex.Dec.22,'31
Ideal Cement 5's, 1943[27]	2-25-32	85	90	
Indiana Limestone units[27]	2-24-32	No market		
Indiana Limestone 6's	2-20-32	15	15½	
International Cem. com.	2-23-32	17	17¾	50c qu. Mar. 31
International Cem. bonds, 5's	2-23-32	62 actual sale		Semi-ann. int.
Iron City Sand & Gravel 6's, 1940[36]	1-21-32	...	70	
Kelley Is. L. & T. new stock	2-24-32	13¾	14	25c qu. Jan. 1
Ky. Cons. Stone com.	2-23-32	...	2	
Ky. Cons. Stone pfd.	2-23-32	...	50	1.75 qu.
Ky. Cons. St. 1st Mtg. 6½'s[45]	2-18-32	30	35	
Ky. Cons. St. V. T. C.[45]	2-18-32	50c	2	
Ky. Rock Asphalt com.	2-23-32	1¾	2¼	
Ky. Rock Asphalt pfd.	2-23-32	25	30	1.75 qu. Dec.1,'31
Ky. Rock Asphalt 6½'s	2-23-32	80	85	
Lawrence P. C.[2]	2-20-32	12	16	
Lawrence P. C. 5½'s, 1942[2]	2-20-32	42	45	
Lehigh P. C. com.	2-23-32	5½	6½	
Lehigh P. C. pfd.	2-23-32	68	70	1.75 qu. Apr. 1
Louisville Cement[45]	2-23-32	175	225	
Lyman-Richey 1st 6's, 1932[13]	2-19-32	95	...	
Lyman-Richey 1st 6's, 1935[13]	2-19-32	90	...	
MarbleheadLime 6's[14]	2-19-32	No market		
Marbelite Corp. com.[35] (cement products)	2-18-32	...	75c	
Marbelite Corp. pfd.[35]	2-18-32	1	...	
Marquette Cem. Mfg. 1st 5's, 1936[46]	2-24-32	90	...	
Marquette Cem. Mfg. 1st 6's, 1936[46]	2-24-32	95	...	
Material Service Corp.	2-23-32	12½	14	
McCrady-Rodgers 7% pfd.[22]	2-18-32	40	45	87½c qu. Dec. 30, 1931
McCrady-Rodgers com.[22]	2-18-32	5	10	75c qu. Jan. 26
Medusa P. C. pfd.[47]	2-24-32	50	60	
Medusa P. C. com.	2-24-32	5	12	
Monarch Cement com.[47]	2-24-32	60	65	
Michigan L. & C. com.[6]	2-20-32	45	...	
Missouri P. C.	2-23-32	...	14	25c qu. Jan. 30
Monolith Portland Midwest com.[9]	2-18-32	75c	1	
Monolith P. C. com.	2-20-32	1½	...	40c s.-a. Jan. 1
Monolith P. C. pfd.	2-20-32	3½	...	40c s.-a. Jan. 1
Monolith P. C. units[9]	2-18-32	8½	10	
Monolith P. C. 1st Mtg. 6's[9]	2-18-32	65	70	
National Cem. (Can.) 1st 7's[27]	2-24-32	90	95	
National Gypsum A com.[27]	2-25-32	2¼	3¼	
National Gypsum pfd.[27]	2-25-32	...	34	1.75 qu. Jan. 2
National Gypsum 6's[3]	2-25-32	55	...	
Newaygo P. C. 1st 6½'s[27]	2-24-32	79	...	
New England Lime 6's, 1935[14]	2-19-32	No market		
N. Y. Trap Rock 1st 6's	2-19-32	68	75	
N. Y. Trap Rock 7% pfd.[30]	2-19-32	52	...	1.75 qu. Jan. 2
North Amer. Cem. 1st 6½'s	2-23-32	19 actual sale		
North Amer. Cem. com.[27]	2-19-32	½	1½	
North Amer. Cem. 7% pfd.[27]	2-19-32	2½	4	
North Shore Mat. 1st 5's[15]	2-24-32	No market		
Northwestern States P. C.[31]	2-23-32	...	76	
Ohio River S. & G. com.	2-23-32	...	8	
Ohio River S. & G. 7% pfd.	2-23-32	...	98	
Ohio River S. & G. 6's[16]	2-19-32	50	70	
Oregon P. C. com.[9]	2-18-32	8	12	
Oregon P. C. pfd.[9]	2-18-32	80	85	
Pacific Coast Aggr. com.[40]	2-18-32	...	25c	
Pacific Coast Aggr. pfd.[40]	2-18-32	...	50c	
Pacific Coast Cement 6's[5]	2-18-32	82	...	
Pacific P. C. com.	2-19-32	1	8	
Pacific P. C. pfd.	2-19-32	...	48	1.62½ qu. Jan. 5
Pacific P. C. 6's[5]	2-18-32	94	...	
Peerless Cement com.[1]	2-19-32	25c	75c	
Peerless Cement pfd.[1]	2-19-32	5	10	
Penn.-Dixie Cement com.	2-23-32	⅞	1⅛	
Penn.-Dixie Cement pfd.	2-23-32	2¾	5	
Penn.-Dixie Cement 6's	2-23-32	42⅛ actual sale		
Penn. Glass Sand Corp. pfd.	2- 3-32	65	75	
Penn. Glass Sand Corp. 6's	2- 3-32	85	90	
Petoskey P. C.	2-23-32	2½	3	
Port Stockton Cem. com.[9]	2-18-32	No market		
Riverside Cement com.[9]	2-18-32	...	12	
Riverside Cement pfd.[9]	2-18-32	55	60	1.50 qu. Feb. 1
Riverside Cement, A	2-19-32	...	8	
Riverside Cement, B[9]	2-18-32	70c	1	
Roquemore Gravel 6½'s,[17]	2-20-32	90	100	
Sandusky Cement 6½'s, 1931-37[19]	2- 6-32	80	100	
Santa Cruz P. C. com.	2-19-32	...	75	$1 qu. Jan. 1 & $2 ex. Dec.24,'31
Schumacher Wallboard com.	2-19-32	1½	...	
Schumacher Wallboard pfd.	2-19-32	12 actual sale		50c qu. Feb. 15
Southwestern P. C. pfd.[35]	2-18-32	70	...	
Southwestern P. C. units[35]	2-18-32	150	200	
Standard Paving & Mat. (Canada) com.	2-23-32	2¼	2½	
Standard Paving & Mat. pfd.	2-23-32	...	30	1.75 qu. Feb. 5
Superior P. C., A	2-19-32	26½	27¼	27½c mo. Mar. 1
Superior P. C., B	2-19-32	5⅜	7	25c Dec. 21, '31
Trinity P. C. units[31]	2-23-32	65	75	
Trinity P. C. com.[31]	2-23-32	10	...	
U. S. Gypsum com.	2-23-32	22½	23	40c qu. Dec.31,'31
U. S. Gypsum pfd.	2-23-32	106	114	1.75 qu. Dec.31,'31
Wabash P. C.[21]	2-20-32	...	18	
Warner Co. com.[16]	2-19-32	4½	5¼	25c qu. Oct.15,'31
Warner Co. 1st 7% pfd.[16]	2-19-32	...	70	1.75 qu. Apr. 1
Warner Co. 6's, 1944, with war.	2-20-32	65 actual sale		
Whitehall Cem. Mfg. com.[30]	2-19-32	...	90	
Whitehall Cem. Mfg. pfd.[30]	2-19-32	...	50	
Wisconsin L. & C. 1st 6's[15]	2-24-32	40	...	
Wolverine P. C. com.	2-23-32	...	3¼	15c qu. Nov.15,'31
Yosemite P. C. A com.[9]	2-18-32	1	1½	

Quotations by: [1]Watling Lerchen & Hayes Co., Detroit, Mich. [2]Bristol & Willett, New York. [3]Rogers, Tracy Co., Chicago. [4]Butler, Beadling & Co., Youngstown, Ohio. [5]Smith, Camp & Riley, San Francisco, Calif. [6]Frederick H. Hatch & Co., New York. [7]J. J. B. Hilliard & Son, Louisville, Ky. [8]Dillon, Read & Co., Chicago, Ill. [9]A. E. White Co., San Francisco, Calif. [10]Lee Higginson & Co., Boston and Chicago. [11]J. W. Jakes & Co., Nashville, Tenn. [12]James Richardson & Sons, Ltd., Winnipeg, Man. [13]Stern Bros. & Co., Kansas City, Mo. [14]First Wisconsin Co., Milwaukee, Wis. [15]Central-Republic Bank & Trust Co., Chicago. [16]J. S. Wilson, Jr., Baltimore, Md. [17]Citizens Southern Co., Savannah, Ga. [18]Dean, Witter & Co., Los Angeles, Calif. [19]Hewitt, Ladin & Co., New York. [20]Tucker, Hunter, Dulin & Co., San Francisco, Calif. [21]Baker, Simonds & Co., Inc., Detroit, Mich. [22]Peoples-Pittsburgh Trust Co., Pittsburgh, Penn. [23]Howard R. Taylor & Co., Baltimore. [24]Richards & Co., Philadelphia, Penn. [25]Hincks Bros. & Co., Bridgeport, Conn. [26]Bank of Republic, Chicago, Ill. [27]National City Co., Chicago, Ill. [28]Chicago Trust Co., Chicago, Ill. [29]Boettcher-Newton & Co., Denver. [30]Hanson and Hanson, New York. [31]S. F. Holzinger & Co., Milwaukee, Wis. [32]Tobey and Kirk, New York. [33]Steiner, Rouse and Co., New York. [34]Jones, Heward & Co., Montreal, Que. [35]Tenney, Williams & Co., Los Angeles, Calif. [36]Stein Bros. & Boyce, Baltimore, Md. [37]Wise, Hobbs & Arnold, Boston. [38]E. W. Hays & Co., Louisville, Ky. [39]Blythe Witter & Co., Chicago, Ill. [40]Martin Judge Co., San Francisco, Calif. [41]A. J. Pattison Jr. & Co. Ltd., Toronto, Canada. [42]Nesbitt, Thomson & Co., Toronto. [44]E. H. Rollins, Chicago. [45]Dunlap, Wakefield & Co., Louisville, Ky. [46]First Union Trust & Savings Bank, Chicago. [47]Anderson Plotz and Co., Chicago, Ill.

Annual Report of Canada Cement

THE PRESIDENT of the Canada Cement Co., Ltd., Montreal, Que., reports for the fiscal year ended November 30, 1931: The current business of the company, namely, dealer business and other business originating during the year, showed considerable recession from the previous year. However, the company benefited from the finishing up of a number of construction projects carried over from the more prosperous years of 1928, 1929 and 1930, so that on the whole the company did a fair volume of business, although its total tonnage was less than in 1930.

Miscellaneous earnings (earnings of associated companies, investments, etc.) showed improvement over the previous year. Economies in operation were effected, due to plant improvements, saving in cost of distribution, and other items. On the other hand, the cost of coal, which is such an important item in the cost of production of cement, increased during the year, and taxation was also heavier.

The plants operated during the year at approximately 60% of their capacity. The reconditioning of the Montreal East plant, referred to in the previous report, was completed early in the year, resulting in better operating efficiency. No. 8 plant at Port Colborne, Ontario, was also overhauled during the year and changes made in the system of production which should result in more economical operation and also better working conditions. The company's plants have all been well maintained.

The steamer *Bulkarier* and electric motor ship *Cementkarrier* both had a successful operating season, free from any serious accidents of navigation, and demonstrated satisfactory earning capacity.

During the year the company through its stock distribution plan gave the employes another opportunity to purchase the company's stock. The response to this offer was very satisfactory. A continually increasing number of the employes are becoming financially interested in the company, so that now 75% of them are stockholders.

Accident prevention has been so successfully carried on at the plants of the company that three of the plants came through the year without a single lost-time accident, and very excellent records were set up by other plants. This is not only a tribute to the accident prevention work carried on at the different plants, but it is also a tribute to the efficiency in such plants, as it is found that accident infrequency and plant efficiency are very closely related.

BALANCE SHEET OF THE CANADA CEMENT CO., LTD.
(As of November 30, 1931)

ASSETS

Current assets:				
Inventories			$ 2,113,609.15	
Accounts receivable (less bad debt reserve):				
Customers' accounts		$929,573.18		
Other accounts		117,323.78	1,046,896.96	
Deposits on tenders			56,058.43	
Deposits under Workmen's Compensation Commission			75,440.63	
Government bonds and other securities			520,266.50	
Cash			1,662,393.33	$ 5,474,665.00
Deferred charges to operations				84,649.44
Investments: In associated companies and other investments				5,607,797.51
Cost of properties: Land, buildings, plant, equipment, etc., less depreciation				39,633,435.21
				$50,800,547.16

LIABILITIES

Current liabilities:				
Accounts payable			$ 737,930.55	
Bond interest accrued and unpresented coupons			105,009.16	
Preference dividend No. 16 payable December 31, 1931			340,679.33	$ 1,183,619.04
Reserves:				
Fire insurance			$ 629,600.35	
Extraordinary repairs and renewals			100,000.00	
Cloth sacks outstanding			150,000.00	
Industrial accidents			70,100.00	
Contingent reserve (a portion of which is available for government income taxes)			513,613.50	
Preference stock sinking fund			13,281.74	1,476,595.59
First mortgage sinking fund gold bonds, 5½%, series "A," due 1947:				
Authorized			$30,000,000.00	
Issued			$20,000,000.00	
Less: Redeemed through sinking fund			822,000.00	19,178,000.00
Purchase money obligations: Payable $300,000 per year for three years				900,000.00
Preference stock 6½% sinking fund cumulative:				
Authorized (of which $21,000,000 has been issued)			$25,000,000.00	
Outstanding				20,965,400.00
Preference stock redemption account: 346 shares redeemed and canceled				34,600.00
Common stock and surplus			$ 6,403,904.75	
Profit and loss account:				
Profit from operations for the year ending November 30, 1931, after making provision of $2,071,101.42 for depreciation of capital assets		$3,111,320.66		
Deduct:				
Bond interest	$1,076,065.83			
Fire insurance reserve	161,624.25			
Reserve for extraordinary repairs and renewals	25,000.00			
Reserve for industrial accidents	7,200.00			
Contingent reserve (for government income taxes, etc.)	275,000.00			
Preference stock sinking fund	13,239.17	$1,558,129.25		
		$1,553,191.41		
Deduct:				
Dividend on preference stock		1,362,751.00		
		$ 190,440.41		
Balance of profits at November 30, 1930		467,987.37	658,427.78	
A total of represented by 600,000 shares of no par value common stock of an authorized issue of 750,000 shares.				7,062,332.53
				$50,800,547.16

Pennsylvania-Dixie Cement

SOME EXTRACTS from the annual report of Blaine S. Smith, president of the Pennsylvania-Dixie Cement Corp., are: For the year ending December 31, 1931, this corporation's operating income before depreciation, depletion and interest was $662,635.85; after interest but before depreciation and depletion, $34,623.23; and after all charges, the loss was $1,358,506.32. The $1,393,129.55 charged for depreciation and depletion is about the same amount as was charged the previous year. A substantial sum was spent for repairs and upkeep which maintained the properties in good physical condition. Expenditures of $105,002.69 were made for capital improvements. No dividends were paid during the year on either preferred or common stock.

The balance sheet attached reflects the liquid condition of the corporation, current assets being equivalent to over 13 times current liabilities, with cash and short term securities of $3,463,985.06, which is greater than at any previous year-end. Net current assets are $5,457,513.08, a reduction from the year before of $661,708.95, occasioned chiefly by bond purchases at favorable prices and by a write-down of inventory value of cloth sacks. Inventories are $770,470.19 less than the previous year-end figure. Depreciated plant account, exclusive of a sum of $264,699.26 covering value of lands in Cuba and elsewhere, transferred from investment account to property account, is $1,334,744.43 less than the year before. Outstanding bonds in the hands of the public totaled $10,123,000, which is $619,500 less than at the end of last year. After providing for 1931 sinking fund requirements there remained in the treasury $706,000 of bonds purchased in the open market in addition to the $1,515,000 of bonds previously drawn down against expenditures for capital improvements, or a total of $2,221,000 principal amount of bonds.

The following surplus adjustments were made during the year:

1. A credit of $267,417.50, being profit on bonds purchased.
2. A credit of $293,781.21, covering excess of par value over cost of 4900 shares of the preferred stock of the corporation held as treasury stock which

was retired. This stock included shares purchased under a plan for resale to employes, which plan is now deferred.

3. A debit of $249,447.50, representing a write-down in inventory value of returnable cloth sacks.

The net credit to surplus from these transactions is $311,751.21.

Due to the adverse business conditions prevailing throughout the year, construction work was on a greatly reduced scale. Reliable figures show that the value of construction contracts awarded for all classes of work was 31% less than 1930; 46% less than 1929; and 55% less than 1928. Cement consumption in the United States, according to U. S. Government figures, was 20% less than the year before and 28% less than the peak year of 1928. This corporation's shipments for the year showed a percentage reduction of less than half of that recorded for the country as a whole. Consumption in 1931 was equivalent to less than half of the country's cement producing capacity.

General business conditions, coupled with the large overcapacity in the industry and reduced demand, brought selling prices to the lowest levels in over 15 years. The corporation's average price realized for the year was more than 30c. per barrel less than the year before and more than 60c. per barrel less than in 1926.

Mill operations were curtailed as compared with the year before, not only on account of reduced shipments, but in order to bring stocks on hand down to the lowest practicable level. At the end of the year these stocks were 500,000 bbl. less than at the previous year-end. Notwithstanding these greatly curtailed operations, the bin cost of cement made was less than in any previous year. Increased efficiency is noted in all operations.

It was necessary to reduce salaries and wages substantially during the year, the average being about 20%. Other economies have been effected in all departments. General, administrative and selling expense for the year was about $300,000 less than the year before, $400,000 less than 1929, and $550,000 less than 1928.

CONSOLIDATED BALANCE SHEET OF THE PENNSYLVANIA-DIXIE CEMENT CORP.

(As of December 31, 1931)

ASSETS

Current assets:			
Cash on hand and in banks		$ 3,081,985.06	
Short term securities		382,000.00	
Notes and accounts receivable:			
Customers, less reserves		346,478.53	
Others		43,480.70	
Inventories at cost or market, whichever is lower, as certified by responsible officials:			
Cement, process stocks, bags, etc.	$1,459,977.90		
Machinery parts and supplies	588,660.18	2,048,638.08	
			$ 5,902,582.37
Fixed assets:			
At reproduction cost, less depreciation, as appraised as of June 30, 1926, plus subsequent additions at cost:			
Land, mineral reserves, buildings, machinery, equipment, etc.		$35,372,160.09	
Less—Reserves for depletion and depreciation		12,089,772.10	
			23,282,387.99
Investments, etc., at less than cost			92,635.83
Deferred charges to future operations			18,289.90
			$29,295,896.09

LIABILITIES

Current liabilities:			
Accounts payable		$ 150,012.32	
Accrued wages, interest, taxes, etc.		268,413.46	
Reserve for federal income taxes		26,643.51	
			$ 445,069.29
Reserves:			
Miscellaneous operating reserves		$ 67,720.18	
Reserve for contingencies		10,000.00	
			77,720.18
First mortgage sinking fund 6% gold bonds, Series A, due Sept. 15, 1941:			
Issued		$14,515,000.00	
Redeemed and canceled		2,171,000.00	
		$12,344,000.00	
Less—Held in treasury		2,221,000.00	
			10,123,000.00
Capital stock and surplus:			
7% cumulative preferred stock:			
Authorized—200,000 shares of $100 each.			
Issued—130,988 shares of $100 each		$13,098,800.00	
(Series A—convertible.)			
Note—Preferred dividends have been paid to Sept. 15, 1929.			
Common stock of no par value:			
Authorized—1,000,000 shares.			
Issued—400,000 shares stated at		4,000,000.00	
Surplus, as per statement attached:			
Balance of surplus provided at organization	$2,055,885.77		
Excess of par value over cost of preferred stock retired	293,781.21		
	$2,349,666.98		
Less—Deficiency in earned surplus	798,360.36	1,551,306.62	
			18,650,106.62
			$29,295,896.09

CONSOLIDATED STATEMENT OF PROFIT AND LOSS AND SURPLUS OF THE PENNSYLVANIA-DIXIE CEMENT CORP. AND SUBSIDIARY COMPANIES

(For the year ending December 31, 1931)

Net sales		$ 6,117,673.99
Manufacturing cost of sales (exclusive of depreciation and depletion) and all other expenses of operating, less miscellaneous income		5,455,038.14
Operating profit before depreciation and depletion		$ 662,635.85
Deduct—Provision for depreciation and depletion		1,393,129.55
Loss from operations		$ 730,493.70
Add:		
Interest charges	$ 628,012.62	
Provision for federal income taxes	None	
		628,012.62
Net loss for the year		$ 1,358,506.32
Deduct:		
Surplus balance at January 1, 1931, as per last account	$ 2,598,061.73	
Profit on purchase of bonds of the corporation under par	267,417.50	
Excess of par value over cost of preferred stock retired	293,781.21	
	$3,159,260.44	
Less—Amount of reserve provided in respect of cloth bags in inventories	249,447.50	
		2,909,812.94
Surplus at December 31, 1931, per balance sheet		$ 1,551,306.62

International Cement Dividend Rate Reduced

THE International Cement Co., New York City, has declared a quarterly dividend of 50 cents, payable March 31 to stock of record March 11, placing the stock on a $2 annual basis against $3 previously.

Virginia-Carolina Chemical Omits Preferred Dividend

THE Virginia-Carolina Chemical Corp. has omitted the dividend of $1.75 due at this time on the 7% cumulative prior preference stock.

Officials say the dividend was passed because of general business conditions and a desire to conserve working capital and provide against operating contingencies.

The company's current asset position is substantially $17,000,000, of which approximately 25% is in cash and government securities, with no debts except current trade accounts amounting to approximately $3,000,000.

In the last eight months the company has purchased approximately 9000 shares of its prior preference stock.

No Action on Warner Second Preferred Dividend

WARNER CO., Philadelphia, Penn., took no action on the quarterly dividend of $1.75 on the second preferred stock due at this time. The regular quarterly dividend of $1.75 on the first preferred was declared, payable April 1 to stock of record March 15.

Recent Dividends Announced

Canada Cement pfd. (qu.)	$1.62½,	Mar. 31
International Cement com. (qu.)	0.50,	Mar. 31
Lehigh Portland Cement pfd. (qu.)	1.75,	Apr. 1
Warner Co. 1st pfd. (qu.)	1.75,	Apr. 1

Specific Suggestions for Change in Anti-Trust Laws

IN A SIGNED ARTICLE in the *Wall Street Journal,* Thomas F. Woodlock writes: "Last month Senator Walsh of Massachusetts introduced a bill 'to protect and foster trade and commerce, to supplement the powers of the Federal Trade Commission, and for other purposes,' the object being to 'thaw out' the situation created by the anti-trust laws. The heart of the bill is in Section 46 which deals with contracts 'to merge, consolidate, acquire stock ownership, fix prices, curtail production, apportion production, apportion sales, apportion territory, pool sales, pool profits, fix resale prices, of patented, copyrighted or trade-marked or otherwise identified goods, or do any act or acts which are prohibited or might be considered prohibited by the anti-trust acts.' All such contracts are to be submitted to the Federal Trade Commission which shall open hearings upon them and after such hearings shall either approve or disapprove the contracts and such approval shall exempt them from the application of the anti-trust statutes. A very important clause in Section 46 (6) reads as follows:

"'Without in any way limiting the power of the Commission to determine whether the contract is or is not in the public interest it shall be considered presumptive evidence that such contract is in the public interest if it results in a fair and reasonable compensation to producers of average ability and efficiency and to labor, and does not result in a selling price of the goods or commodities covered thereby in excess of a fair and reasonable price based on all fair and reasonable items of cost plus fair and reasonable profit, but the burden of proving that the contract is in the public interest shall be on the petitioner.'

"Here we have clearly emergent the 'just price' and the 'just wage' of mediaeval days, with a strong suggestion of the mediaeval guild system—all perfectly good ethics and therefore perfectly good economics. And we have the regulative power removed from the Courts acting *post factum* to a Commission acting *ante factum* which is the most obvious kind of common sense. Without accepting every detail of Senator Walsh's bill as sound and well-adapted to the end in view, it can be said that it correctly envisages that end and takes the most direct road to that end. Further, it can be said of it that it is distinctly preferable to a bill which would amend either the Sherman Act or the Clayton Act—or so it seems to this writer. As a matter of fact, the Sherman Act's language needs no amendment but only an interpretation which shall give to the words 'restraint of trade' their true meaning in the light of today's facts. So far as the Clayton Act is concerned, Senator Walsh's bill would take care of that.

"Recognition of the destructive effects of unrestrained competition is one of the outstanding fruits and profits of the present world-emergency and it is earnestly to be hoped that we shall garner it for use. It is lawful for us, as the Latin poet had it, to learn from the enemy. Every heresy derives whatever vital power it possesses from the fragment of truth that underlies it, and the emphasis of the classical Socialists upon the principle of Cooperation is the secret of the vitality in the Socialist *weltanschauung.*

Cooperation Needed

"Nature (to borrow that convenient phrase signifying the general 'order of things') has forced the world into most intimate economic relations with cooperation as their fundamental principle and we now find that she has no use at all for the principle upon which Adam Smith and his followers relied, *i. e.,* free and unrestrained competition between individuals. The unfortunate thing is that while we see this to be true in the economic order we are far from seeing that it holds true also in the political order. Nationalism in the latter is the equivalent or analogue of unlimited competition in the former, and is fully as deadly in its consequences. Both will be, in fact, destructive of our system of civilization if allowed to run their course unchecked.

"'Regulation' of trade and commerce was a necessary part of the guild system and is a necessary part of any economic system which bases upon cooperation. The rules and practices of the guilds were very carefully drawn and were jealously watched by the courts of the day. It was, indeed, in guild days that regulation of 'public utilities' originated, was accepted and was practiced even before the law of contract took shape. As this writer tried to point out some time ago, the notion that 'utilities' are 'public' because they perform governmental functions is a pure modern invention without the slightest support in history, law or common sense, presumably advanced to support the 'prudent investment' theory of value for rate making after a large advance in commodity prices. Nobody likes 'regulation' but it is necessary for the reason that law is necessary, and we must make up our minds to accept it as a lesser evil than the evil of anarchic competition.

"When, as and if the world can achieve an end to the war and once again start something like normal trading we shall have to consider very seriously legislation on much the same lines as those laid down in Senator Walsh's bill. If we could do it meantime, so much the better."

Highway Work Should Proceed at Present Pace

"TO THE UNINFORMED observer it might appear that the amount of money being spent on the nation's highways is out of line with actual needs, hence a tendency on the part of those who do not understand road building and highway transportation requirements to cripple highway work."

This statement was issued recently by Frederic E. Everett, president of the American Association of State Highway Officials, in commenting on the necessity of continuing road building on its present scale. He went on:

"First of all, we need good roads because we have some 26,000,000 passenger cars, trucks and busses, vehicles which during the lean year of 1931 were given a greater usage than ever before. Every dollar taken away from road building reduces the utility of the automobile and therefore its value. Every dollar spent in road betterment makes the car worth more. Neither the highway nor the automobile can be evaluated alone; both must be weighed together and considered as a single transportation medium.

"In view of the urgent need for more improved roads, the cash benefits received, the employment of three-quarters of a million men on state and local roads, road building this year and in years to come should maintain its pace.

"No cog in the wheel should be hacksawed. Money dedicated by motorists through gasoline and motor vehicle taxes to the cause of good roads should be used for good roads. Every state should fight gasoline tax evasion, which is costing us upwards of $40,000,000 a year. Federal participation should continue in full measure. States must meet this Federal challenge. Local communities should also realize that the road dollar performs a money-saving function, that if properly spent it is a dollar as solidly invested as though it were in government securities," concluded Mr. Everett.

Pass Bill to Aid in Establishing Cement Plant

A BILL that will give Raritan township, New Jersey, more than $180,000 in revenue and end its financial difficulties was passed recently.

If the measure becomes a law, the Edison Cement Corp. will establish a cement plant there.

In taking over the abandoned plant of the Building Materials Corp., a war-time potash concern, the Edison company has agreed to pay $100,000 in back taxes and interest, $15,000 advance on this year's taxes and to take $60,000 of the township's tax anticipation notes. In addition, the plant will give the township $500,000 additional ratables and will give employment to 200 persons.—*Newark* (N. J.) *News.*

Foreign Abstracts and Patent Review

Shaft Lime Kiln for Natural Gas. Goslich states that the Rheinische Kalksteinwerke, which fired its lime shaft kilns originally with generator gas, is now firing them with district gas (natural gas through long-distance pipe lines). Each of the Mueller kilns (German Patent No. 346,565) produces 60 to 65 tons in 24 hours. The supply ducts for the gas flames are so distributed over the oval cross section of the kiln that there are two ducts on each long side and more ducts enter diagonally on each short side. This assures a uniform burn over the entire cross section, also with maximum capacity operation. No heating element is therefore necessary in the axis of the shaft kiln. The gases are mixed with the air and the flames are developed outside of the actual shaft so that escape of burned gases through the shaft is impossible. Each burner is independently controllable. The unburned raw material at full capacity operation is never over 3%.

Gas consumption amounts to 213 cu. m. of gas with heating value of 4000 kilocalories per ton of burned lime with the raw stone containing 95 to 97% $CaCO_3$. This corresponds to a heat consumption of 852 kilocalories per kg. (1533.6 B.t.u. per lb.) of burned lime. The efficiency when firing with district gas is therefore 75 to 80%, which is due to the special shape of the shaft and the good regulating ability of the individual burners. When firing with generator gas, the gas consumption was 785 cu. m. of gas with heating value of 1100 to 1200 kilocalories 1554.3 to 1695.6 B.t.u. per lb.) per ton of burned lime. The burned lime is chemically clean. Hirsch determined in 1927 that in gas-fired shaft kilns, the linings of which are exposed to severe operating conditions, first of all magnesite or silicon carbide, and second quartz materials and such brick as have high alumina content, are suitable. Now a special silicate material is available which has a service life equivalent to 20,000 tons of burned lime.—*Tonindustrie-Zeitung* (1931) **55,** 91, pp. 1263-1264.

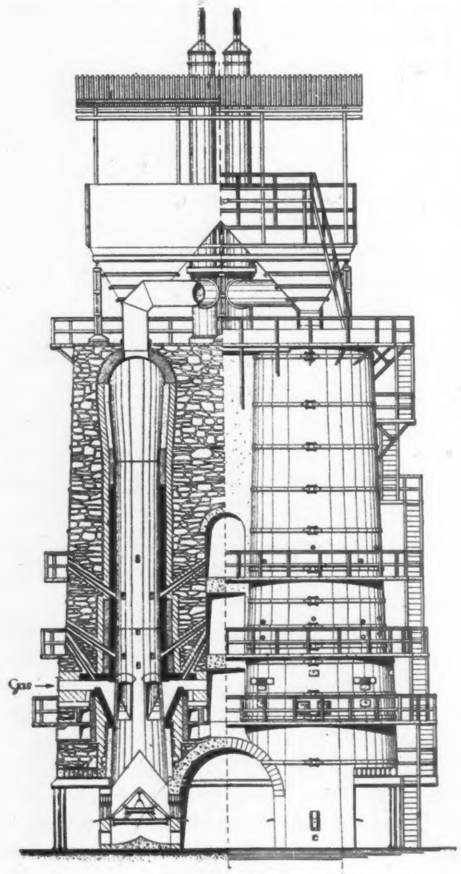
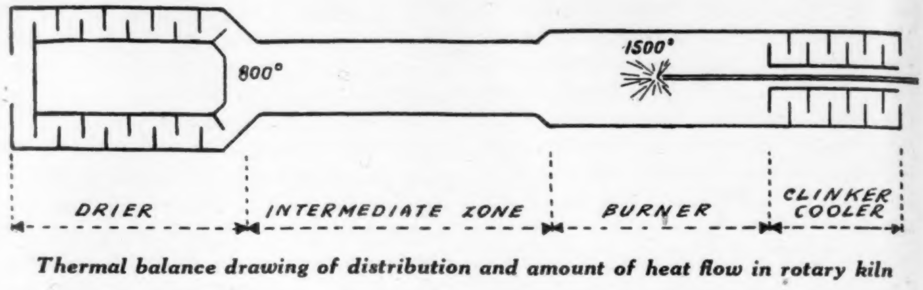


Fig. 1. A gas-fired lime shaft kiln

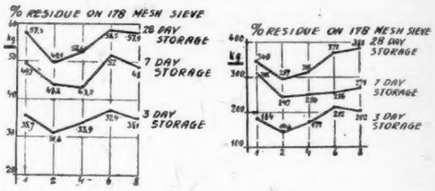


Thermal balance drawing of distribution and amount of heat flow in rotary kiln

Thermic Study of Cement Making. H. Lefort presents first a theoretical discussion of the relations, distribution, and amounts of heat flow in kilns, and thermic balance drawings of the same. A practical application is then made to the vertical and the rotary kilns. The surface and time of contact of the raw material and the kiln gases are quite insufficient for a good utilization of the rotary kiln heat. Even when using such means as elongation of the kiln, introduction of obstacles such as chains and coils into the kiln, charging by injection, pulverizing of the mix, etc., very incomplete results are obtained and the wet process continues to exact a large consumption of fuel, the waste gases and steam leaving always at an excessive temperature.

The author proposes a burning arrangement with artificial draft providing as a continuation of the kiln an apparatus calculated to dry the mix and to permit recovery of the heat of the gases within the best possible limit. Thus the consumption of fuel would not be more than in the dry or mixed process. An accompanying illustration gives an idea of the design and the thermic function of such an apparatus. The arrangement consists of air drier for the mix, intermediate zone, burning zone, and clinker cooling zone. Several types of driers for drying slurry up to 40% water content are shown in cross section and in longitudinal section.—*Revue des Materiaux de Construction et de Travaux Publics* (1930) 248, pp. 171-176.

Fine Grinding and Cement Quality. F. Richner presents curves showing that in the case of earth-damp mortars from portland cement the compressive strengths give



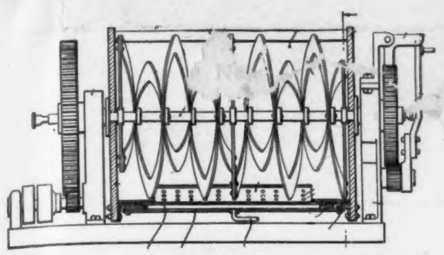
Relation of fineness to strength

ever higher figures with increasing fineness of the cement, but that the flexural strengths and the compressive strengths of plastic consistency decrease constantly at finer grinding (below a residue of 8% on the 178-mesh sieve) and then jump upward only after 1% residue is attained.—*Tonindustrie - Zeitung* (1931) **55,** p. 1289.

Recent Process Patents

The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington, D. C. Complete copies may be obtained by sending 10c to the Commissioner of Patents, Washington, D. C., for each patent desired.

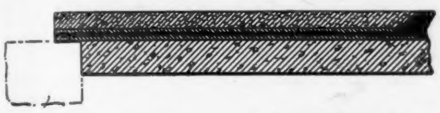
Cellular Cementitious Material. The authors of this patent point out that metallic dusts when added to portland cement paste, due to the calcium hydrate in the cement, generate hydrogen gas, giving the set concrete a porous structure. They also refer to comparatively old methods whereby a foam is added separately to the paste for the same purpose. This patent describes methods and machines for incorporating air into a cement paste so as to result in porous concrete, which consist of various modifications of machines that combine mechanical agitation with air blasts in conjunction with "Cell" solutions of various compositions. The "Cell" solution is material incorporated in the paste which adds toughness and tenacity to the walls of the air bubbles. They prefer to use for this purpose a solution of casein, 100 parts by weight, water 450 parts,



Machine for producing porous concrete

and calcium hydrate 60 parts. Alum, glue, arsenious acid, calcium chloride and potassium hydrate are also used in preparing the "Cell" solution. Details of the process and equipment are described. *John A. Rice and Richard B. Rice, U. S. Patent No.* 1,769,309.

Reinforced Asbestos-Cement Wallboard. The patentee describes an asbestos-cement wallboard consisting of ordinary asbestos-cement wallboard covering to which has been cemented a thin layer of cork board or other vegetable thermal insulating material. He proposes to use sorrel or Lumnite cements

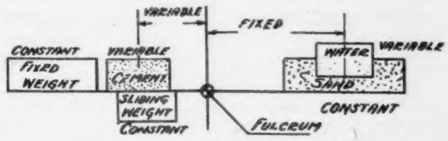


An insulated and reinforced wallboard

as the bonding material. A metal wire reinforcement can also be used. The invention is said by its author to add greater rigidity to asbestos-cement wallboard and to reduce its flexibility. *Louis Lane, U. S. Patent No.* 1,763,469.

Bumping Screen. The screen shown is intended especially for separating asbestos from rock minerals, but the inventor says it can be used for other materials. The screen is a flat bed carried on rollers and free to move back and forth. At the end of the supporting frame is a bumping post. The screen is carried away from the post by a cam on a shaft driven by a belt. When the cam lets go the screen is drawn against the post by counterweights and springs. The bump stops the screen but the particles on it slide ahead by their own momentum. In the form shown there is a series of screens on the main screen frame, running from fine to coarse. Below each of these is a funnel to catch the undersize and turn it into chutes. *R. Q. Kyle, U. S. Patent No.* 1,790,429.

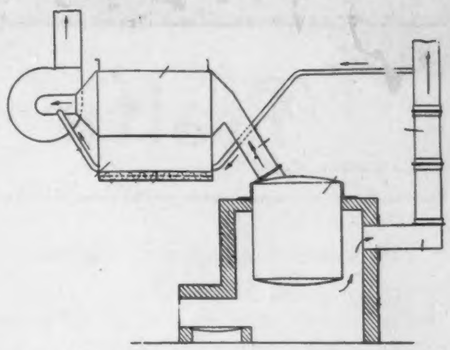
Water-Cement Ratio Concrete Batcher. The description of this device is long and detailed because it includes a number of ingenious devices for mechanically performing the operations needed. But the principle is simple and can be easily understood from the accompanying diagram. The machine has the usual measuring hoppers for cement, sand and coarse aggregate. The coarse aggregate goes directly from the measuring hopper to the mixer, but the sand and cement flow into balancing hoppers. Enough water is added to the sand so that it is just not flooded, in which condition it can be uniformly measured in the measuring hopper. The sand balancing hopper carries a weight equal to that of the cement used. The cement balancing hopper carries a weight equal to that of the bone dry sand



Illustrating principle of batcher

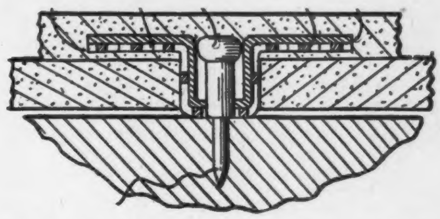
and an additional weight equal to the weight of the water required for the water-cement ratio wanted. A sliding weight permits this ratio to be changed as needed. After the cement and the sand are in their hoppers more water is added to the sand hopper until both hoppers balance. Then these hoppers are dumped into the mixers. A consideration of the balancing shows that the batch must consist of the required amounts of cement, coarse aggregate and dry sand and just the water required by the water-cement ratio chosen, including whatever water was in the wet sand. The bad effects of bulking are avoided and the correction for water held by the sand is made automatically. *P. J. Halloran, U. S. Patent No.* 1,790,813.

Gypsum Dust Collector for Calcining Kettles. The invention comprises the utilization of sufficient heat applied to parts of the dust collector to keep the temperature above the dew point. A dust collector of any desired form may be used with a jacket or casing constructed around the body of the collector and specifically around a screw conveyor which removes the collected dusts. Waste hot gases are taken from the combustion stack and passed through this jacket by means of an exhaust fan that also removes the steam and entrained dust from the kettle proper. *Joseph B. Taylor, U. S. Patent No.* 1,770,020.



Dust collector for calcining kettles

Means for Hanging Wallboard. The patentee describes his method of attaching wallboard to the studding consisting of a nail having a metal covering and a special metal staple. The nail and staple are driven between the joints of the wallboard, thus permitting lateral movements in the board

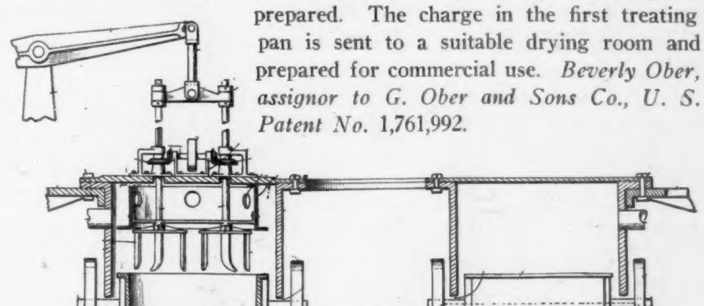


Permits lateral movement of board

without damage thereto. The author of this patent has covered a somewhat similar idea in his patent No. 1,763,262. *Henry R. Shanks, U. S. Patent No.* 1,763,263.

Apparatus for Manufacturing Acid Phosphate. In the author's process the charge, after being mixed with sulphuric acid, is handled in such a manner as to maintain the porosity of the mass preventing the sealing of the pores in the semi-solid mass during the entire leaching process. Sealing of the pores impedes the action of the crystallization, which is undesirable. The porosity is maintained by a specially designed mixer which consists of a series of pans mounted on a circular table. Above the table is suspended a stirring device that can be raised or lowered into the charge in a given pan. Rotation of the circular table brings a second pan up to the agitating device, where a second phosphate charge is prepared. The charge in the first treating pan is sent to a suitable drying room and prepared for commercial use. *Beverly Ober, assignor to G. Ober and Sons Co., U. S. Patent No.* 1,761,992.

Counterweights and springs jar screen



Special mixer maintains porosity

Traffic and Transportation

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week ending February 20:

NEW ENGLAND FREIGHT ASSOCIATION DOCKET

24582. **Sand, blasting, core, fire or sea** (See Note 3), from Onset, Mass., and Dansville, R. I., to Waterloo, Que. Present — 33½; proposed — 21½. Reason: Same rates as in effect from Provincetown to Ottawa, Ont.

TRUNK LINE ASSOCIATION DOCKET

M-1988. **Crushed stone,** carloads (See Note 2), from Jamesville, N. Y., to Weedsport, N. Y., and Port Byran, N. Y., 75c per net ton. Rate to expire December 31, 1932.

28595. **Sand, common,** carloads (See Note 2), from Philadelphia, Penn., to Reading, Penn., 99c per net ton, subject to emergency charges. Expires March 31, 1933, and $1.05 per net ton, effective April 1, 1933. (See Note 4.)

28615. **Sand,** other than blast, engine, foundry, molding, glass, silica, quartz or silex, carloads (See Note 2), from Shippensburg, Penn., to Reading, Penn., $1.60 per net ton. (Present rate $1.95.) (See Note 5.)

28625. **Stone** (natural) **crushed, coated** or not **coated with oil, tar or asphaltum,** carloads (See Note 2), from Munns, N. Y., to Erie Railroad stations: Narrowsburg, Stockport, Deposit, N. Y., Lanesboro, Thompson, Susquehanna, Penn., Johnson City, Oswego, Waverly, Horseheads, Corning, N. Y., and various. Rates ranging from $1.20 to $1.60 per net ton on uncoated crushed stone and rates ranging from $1.30 to $1.70 on coated crushed stone. (See Note 5.)

M-2003. **Stone, crushed or broken, and stone screenings,** carloads (See Note 2), from Cavetown and Security, Md., to Oldtown and Town Creek, Md., 75c per net ton, subject to emergency charge and to expire December 31, 1932. (See Note 4.)

28662. **Crushed stone,** carloads (See Note 2), from Northampton, Penn., to D. L. & W. R. R. stations, Delaware Water Gap, Stroudsburg, East Stroudsburg, Analomink, Henryville, Cresco, Mountain Home, Penn., $1.10, and Mt. Pocono, Pocono Summit, Tobyhanna and Gouldsboro, Penn., $1.20 per net ton. (See Note 5.)

28666. **Sand and gravel,** other than blast, engine, foundry, glass, molding or silica, carloads (See Note 2), from Susquehanna, Penn., to Hawley, Hoadleys and Gravity, Penn., $1.20 per net ton. (Present rate, $1.25.) Reason: Proposed rate compares favorably with rates to Millerton, Penn., and Painted Post, N. Y.

28670. **Slag,** carloads (See Note 2), from Hokendauqua, Penn., to Cresco and Mountain Home, Penn., $1.10 and Mt. Pocono, Pocono Summit, Tobyhanna and Gouldsboro, Penn., $1.20 per net ton. (See Note 5.)

28676. **Sand and gravel,** carloads (See Note 2), from Farmingdale, N. J., to Belford, N. J., 36½c per net ton (to expire December 31, 1932, and to be subject to Agent Curlett's Emergency Tariff). (Present rate, 60c.) (See Note 4.)

28677. **Sand** (common), **gravel and crushed stone,** carloads (See Note 2), from Philadelphia (Port Richmond), Penn., to Grenloch, N. J., 80c per net ton. Subject to emergency charges. (See Note 5.)

28679. **Marble, crushed, and marble screenings,** in bags or in bulk, straight or mixed carloads, minimum weight 60,000 lb., from Harrisonburg, Va., to Williamsport group points as per Southern Railway Tariff I. C. C. No. A-10359, 22½c per 100 lb.

M-2014. **Crushed stone,** carloads (See Note 2), from Bound Brook, N. J., to all stations on the Rahway Valley Railroad, 70c per net ton. (See Note 5.)

28683. **Glass sand,** carloads (See Note 2), from Triplett, Gore, Va., to Charleston and Huntington, W. Va., $2.60 per net ton. (Present rate, $2.70.) Reason—Proposed rate is comparable with rates from Mapleton, Penn.

CENTRAL FREIGHT ASSOCIATION DOCKET

30486. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) and **gravel,** carloads, from Hugo, O., to points on the N. Y. C. R. R., viz., Wattsville, 85c; Amsterdam, 90c; Hopedale, 95c; Bradley and Smithfield, O., 100c per net ton. Present, 90c to Wattsville; 100c to Amsterdam and Hopedale; 110c per net ton, Bradley, and 6th class basis to Smithfield, O.

30488. To cancel present commodity rates published on pages 152 and 153 of C. C. C. & St. L. Ry. Tariff 1703P, on **sand and gravel,** as described in commodity descriptions "A," "B," "G," "M" and "N," carloads, from Cement City, Mich., to various destinations in Ohio, Indiana and Michigan, classification basis to apply in lieu thereof.

30500. To establish on **molding sand,** carloads, from Eau Claire, Mich., to Detroit, Mich., rate of 164c per net ton. Present—189c per net ton, emergency increase in addition.

30501. To establish on **stone, crushed** (in bulk), and **limestone, unburned agricultural** (in bulk in open top cars only), carloads, from Holland, O., to Middlebury, Ind., rate of 115c per net ton. Present—125c.

30511. To establish on **sand and gravel,** carloads, from Columbus, O., to Thornville, Yost and Glenford, O., rate of 70c per net ton. Route: Via B. & O. R. R. direct. Present, 75c to Thornville, and 80c per net ton to Yost and Glenford, O.

Note 1—Minimum weight marked capacity of car.

Note 2—Minimum weight 90% of marked capacity of car.

Note 3—Minimum weight 90% of marked capacity of car, except that when car is loaded to visible capacity the actual weight will apply.

Note 4—Reason—To meet motor truck competition.

Note 5—Reason—Proposed rates are comparable with rates on like commodities for like distances, services and conditions.

30517. To establish on **agricultural limestone,** not ground or pulverized, in open top cars, carloads (See Note 3), from Whitehouse, O., to Morenci and Britton, Mich., rate of 97c per net ton. Present—92c.

30519. To establish on **crushed stone,** carloads, from Huntington, Ind., to Middlebury, Ind., rate of 115c per net ton. Route: Via Wabash Ry. to Fort Wayne, Ind., N. Y. C. R. R. beyond. Present—15c (Classification basis).

30525. To establish on **sand,** viz.: **lake, river and bank,** other than sand loam, carloads, from Calumet, Gary, Willow Creek, Crocker, Ind., to De Kalb, Ill., rate of 139c per net ton. Route: Via Wabash Ry., Chicago, Ill., C. & N. W. Ry. Present—Combination basis.

30529. To cancel rate of 239c per net ton applicable on **ground limestone,** in carloads, minimum weight, 40,000 lb., unless capacity of car is less, in which case actual capacity of car is to be the minimum weight from Dunbury and Marblehead, O., to Franklin and Greenfield, Ind., applying in lieu thereof classification basis.

30536. To establish on **crushed stone,** in open top cars, carloads, from McVittys, O., to Coshocton, O., rate of 100c per net ton. Present rate—17c (sixth class).

30538. To establish on **slag, crude, granulated, crushed or commercial** (the product of iron and steel furnaces), in bulk, in open top equipment, carloads, from Hamilton, O., to Winchester, 95c; Greenwood, 130c, and Huntington, Ind., 125c per net ton. Present—260c to Winchester, 320c to Greenwood and 360c per net ton to Huntington, Ind.

30542. To establish on **sand,** viz.: **Blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding and silica,** carloads, from Lake Ciecott, Ind., to Danville and Hoopeston, Ill., rate of 139c per net ton. Present —154c per net ton.

30552. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) and gravel, carloads, from Sandusky, O., to North Randall, O., rate of 90c per net ton. Present—120c.

30554. To establish on **stone, lake or river filling** (offal of quarry), carloads, all cars to be loaded to cubical or visible capacity, from Amherst, O., to Frankfort, Mich., rate of 185c per net ton. Present rate, 440c.

30608. To establish on **crushed stone,** also **limestone, agricultural** (not ground or pulverized), in bulk, in open-top cars only, carloads, from Huntington, Ind., to Hamilton, 95c; Ashley Hudson, 100c; Hilmer, Stroh, S. Milford, Wolcottville, 105c; Eddy, 110c; Topeka, Stony Creek, Millersburg, 105c; Benton, New Paris, Foraker, 100c; Wakarusa, Wyatt, 105c; Lakeville, Pine, North Liberty, 110c; Dillan, Kingsbury, Magee, 115c; Westville, Morris, 120c; Crocker, Willow Creek, Gary, Tolleston, Ind., 125c per net ton. Present—110c to Hamilton; 113c, Ashley Hudson; 127c, Hilmer; 120c, Stroh; 127c, South Milford, Wolcottville, Eddy, Topeka, Stony Creek, Millersburg; 130c, Benton, New Paris, Foraker; 135c, Wakarusa, Wyatt; 138c, Lakeville, Pine; 140c, North Liberty, Dillan, Kingsbury; 145c, Magee, Ind.

30629. To establish on **gravel, crushed** or ground, but not less than 60,000 lb., from East St. Louis, Ill., to Cleveland, O., rate of $1.10 per net ton. Present, 24c (6th class), or $4.80 per ton.

30630. To establish on **agricultural limestone,** in box cars, carloads, minimum weight 50,000 lb., from Gibsonburg and Woodville, O., to Milwaukee, Wis., rate of 260c per net ton. Present—280c.

30631. To establish on **sand, lake or beach, and gravel,** when loaded in open top cars, carloads, from Erie, Penn., to Glassport and Wylie, rate of 120c via N. Y. C. R. R., Youngstown, O., P. & L. E. R. R., and 140c per net ton, to Woodville Junction, Penn., via N. Y. C. R. R., Youngstown, O., P. & L. E. R. R., McKees Rocks, Penn., and P. C. & Y. Ry. Present, 140c to Glassport and Wylie, and 150c per net ton to Woodville Junction, Penn., per N. Y. C. R. R. Tariff I. C. C. L. S. 1413.

30635. To establish on **crushed stone, crushed stone screenings, crushed stone tailings and agricultural limestone,** carloads, in open top cars, minimum weight, from Carey, O., to Strasburg, O., rate of 120c per net ton. Route—Via Penn. R. R. Present, 17c.

30636. To establish on **crushed stone, crushed stone screenings, crushed stone tailings and agricultural limestone,** carloads, in open-top cars, actual weight will apply, from Carey, O., to W. & L. E. Ry. stations: Scio, 125c; Dillonvale, 140c; Neff, 150c; Steubenville, 150c; Martins Ferry, 150c per net ton. Present—150c to Scio; 175c, Dillonvale; 189c, Neff; 195c, Steubenville, and 188c per net ton, Martins Ferry, O.

ILLINOIS FREIGHT ASSOCIATION DOCKET

4181. **Crushed stone,** as described in Illinois Freight Classification No. 15, C. W. Galligan's I. C. C. 179, from Alton, Ill., to Springfield, Ill. Present — 76c per net ton. Proposed — Illinois Freight Classification basis.

WESTERN TRUNK LINE DOCKET

2556-X. **Sand,** carloads (See Note 2), but not less than 40,000 lb., from Hager and Maiden Rock, Wis., to Oregon, Ill. Rates: Present—$1.90 per net ton. Proposed—$1.30 to apply as a proportional rate on traffic destined to points east of the Illinois-Indiana State Line.

7844. **Sand, silica,** in box cars, carloads, minimum weight as prescribed by the Interstate Commerce Commission in Docket 17000, part 11-A, from Missouri producing points to Kansas City, Mo.-Kan.

6025-E. Rates and minimum weights: **Limestone, crushed or ground,** carloads, from Valmeyer, Ill., to Omaha, South Omaha, Neb., Council Bluffs, Ia., and points in North Dakota and South Dakota. Rates: Present—Class and combination rates. Proposed—To representative points: (See Note 3.)

To	Proposed
Omaha, Neb.	290
Mitchell, S. D.	540
Sioux Falls, S. D.	530
Rapid City, S. D.	710
Fargo, N. D.	690

7807. Rates, **limestone, crushed,** carloads, minimum weight 50,000 lb., from Bedford, Ind., district, to Ottawa, Ill. Rates, present, $2.30 per net ton; proposed, $1.90.

I. C. C. Decisions

23898. **Cement to New Mexico.** The Interstate Commerce Commission, by division 3, in **23898,** Iola Cement Mills Traffic Association et al. vs. A. T. & S. F. et al., **23899,** Southwestern Portland Cement Co. vs. T. & P. et al., **23902,** Oklahoma Portland Cement Co. vs. A. T. & S. F. et al., **23995,** San Antonio Portland Cement Co. vs. I.-G. N. et al., and **24133,** Republic Portland Cement Co. vs. G. C. & S. F. et al., has ordered a new line of rates on cement from the Kansas gas belt, Dewey and Ada, Okla., and related points in Texas to destinations on the Texas-New Mexico in New Mexico and Texas, not later than May 16. The present rates have been found unreasonable and unduly prejudicial. The title complaint alleged the rates were unduly prejudicial to the parties therein and unduly preferential of North Fort Worth, Eagle Ford, Harrys, Tex., and Ada, Okla.

New rates, which the commission said would be reasonable and would remove the undue prejudice, are to be made on the basis of rates prescribed in Oklahoma Portland Cement Co. vs. D. & R. G. W. 128 I. C. C. 63, called the Texas case in this report. In addition to prescribing new rates, the commission awarded reparation.

22596. **Slag.** A revamping of the adjustment on slag from points in eastern Pennsylvania to destinations in trunk line and New England territories has been ordered in **22596,** National Slag Co. et al. vs. Atlantic City Railroad Co. et al., two sub-numbers thereunder, Duquesne Slag Products Co. vs. Same, and William S. Buckland, trading as the Philadelphia Slag Co. vs. Same; **222954,** Keystone Slag Co. vs. Same; and **22511,** Keystone Slag Co. vs. B. & A. et al. The Interstate Commerce Commission, by division 2, in a report written by Commissioner Tate, has found the existing rates unreasonable but not otherwise unlawful. The new rates are to be based upon scales, one applicable to destinations in trunk line, and the other to destinations in New England, effective not later than April 15.

The commission found the rates assailed in 22596, and the two sub-numbers thereunder, not unduly prejudicial, but that they and the rates assailed in 22954 and 22511 were and for the future would be unreasonable to the extent they exceed or may exceed the rates shown in Scale A to points in Delaware, Maryland, New Jersey, New York, Virginia, West Virginia, and the District of Columbia, and under Scale B to points in New England, subject to the addition of 20c a net ton to the rates under Scale A for movements over two or more line-haul carriers and subject to the addition of 70c a ton to the rates under either scale for hauls involving car float or lighterage service in the New York Harbor district on traffic to points in New England or New York, including destinations on the Long Island Railroad located in group A. The commission further found that the rates to Long Island groups B, C and D should be made by adding to the rates herein prescribed to group A arbitraries of 20c to group B, 30c to group C, and 60c to group D.

Scale A begins with a rate of 60c a net ton for 15 mi. and under: becomes 110c at 100 mi.; 150c at 200 mi.; 190c in the block between 290 and 320; and runs out with a rate of 200c for the block between 320 and 350 mi.

Scale B begins with a rate of 150c for hauls in the block between 100 and 125 mi.; becomes 185c for the block between 175 and 200 mi.; 235c for the block between 290 and 320 mi.; 250c for the block between 320 and 350 mi.; 275c for the block between 380 and 410 mi.; 310c for the block between 470 and 500 mi.; and runs out with a rate of 335c for the block between 530 and 550 mi.

The report says that distances shall be computed over the routes composed of not more than three line-haul carriers, by existing connections for the interchange of carload traffic which will result in the lowest rates, taking into consideration a joint line differential and the arbitrary for float service. It says the lines which deliver the traffic to other carriers at point of origin shall not be considered line-haul carriers. In computing rates for hauls involving car-float or lighterage service in New York Harbor, only the actual rail distance shall be used, the 70c arbitrary being intended to cover the entire water service. The emergency charges authorized in the Fifteen Per Cent Case, 178 I. C. C. 539, 179 I. C. C. 215, the report says, may be added to these rates.

A further finding is that the rates assailed in 22511 have been unreasonable since October 30, 1928, to the extent that they have exceeded the rates herein prescribed for the future. Reparation has been awarded in that case.

To Investigate Rates on Aggregates in Ohio

THE Interstate Commerce Commission, in 25020, rates on crushed stone, gravel, sand and slag within the state of Ohio, at the request of railroads operating in Ohio, Pennsylvania and West Virginia, has instituted a 13th section inquiry into the rates mentioned in the title of the proceeding, established and maintained by orders of the Public Utilities Commission of Ohio. It has joined with the proceeding 24597, Bessemer Limestone and Cement Co. vs. Akron and Barberton Belt et al.; and four subnumbers thereunder, Same vs. Same; Lake Erie Limestone Co. vs. Same; Standard Slag Co. vs. Same; and Union Limestone Co. vs. Same.

Rates, alleged in the petition of the railroads and in the complaints to be unduly prejudicial to the complainants and unjustly discriminatory against interstate commerce, were established or have been maintained by orders of the Ohio commission dating as far back as September 29, 1921, and as recently as May 25, 1929. The proceeding, the Commission's order says, will be assigned for hearing at such times and places as it may hereafter direct.

Oppose Rate Increase in Kansas

DECLARING that if the railroads put into effect the recently authorized interstate tariffs applying to intrastate traffic they would cause shippers to use trucks, H. M. Hancock, Salina, Kan., voiced strong opposition to the increase recently.

The carriers were before the public service commission with a proposal to hike the intrastate rates to conform with interstate rates granted by the interstate commerce commission.

W. S. Barton, traffic manager, Ash Grove Lime and Portland Cement Co., Kansas City, Mo., testified that the proposed rates would hit southeastern Kansas cement plants a serious blow.—*Morland* (Kan.) *Monitor.*

Industrial Service Organization Formed

A NEW TYPE of service organization, to facilitate the marketing of industrial products, has been formed by Dr. H. H. Sheldon, H. A. Morse, L. W. Hutchins, and Dr. W. H. Easton. The company, with offices at 191 West 10th St., New York City, will be known as Sheldon, Morse, Hutchins and Easton.

This group plans to furnish manufacturers with a complete sales research, advertising, and publicity service, based on their experience in the promotion and sales of chemicals, electrical equipment, building materials, industrial and marine supplies and machinery, scientific apparatus, and other lines.

Dr. Sheldon is the chairman of the physics department, Washington Square College, New York University, consulting science editor of the New York *Herald-Tribune,* and author of numerous scientific works.

Mr. Morse is president of H. A. Morse, Inc., industrial advertising and marketing counsel and was formerly managing editor of *Building Age and National Builder.*

Mr. Hutchins is director of public relations for the Swann Chemical Corp., director of the American Institute and treasurer of the Junior Institute of Arts and Sciences.

Dr. Easton was for many years with the Westinghouse Electric and Manufacturing Co. as an executive on advertising, sales promotion, and national publicity, and is past-president of the Technical Publicity Association of New York City.

Among the services rendered are: the determination of markets, evaluated for consumption and profit; the determination of salesmen's needs; the organization of sales record systems; the planning and execution of magazine and direct-mail advertising; patent surveys; and the preparation of manufacturers' exhibits, etc.

Continue Suit in Blasting Case

THE SUIT of George N. Brewster and Sons Co., owners, and the Hudson County Crushed Stone Co., operators of a quarry west of the Bergen pike, North Bergen, N. J., against the township of North Bergen, to restrain officials from interfering with blasting operations, was continued.

In the interim, the court continued the preliminary injunction issued in the fall, restraining the police from interfering with the blasting.

Negotiations are in progress between the litigants and blasting tests are about to be made in an effort to arrive at some common ground.—*Hoboken* (N. J.) *Observer.*

Portland Cement Production, January

THE PORTLAND CEMENT INDUSTRY in January, 1932, produced 4,989,000 bbl., shipped 3,363,000 bbl. from the mills, and had in stock at the end of the month 25,568,000 bbl. Production of portland cement in January, 1932, showed a decrease of 24.4% and shipments a decrease of 28.3%, as compared with January, 1931. Portland cement stocks at the mills were 7.9% lower than a year ago.

The statistics here presented are compiled from reports for January, received by the Bureau of Mines from all manufacturing plants except three, for which estimates have been included in lieu of actual returns.

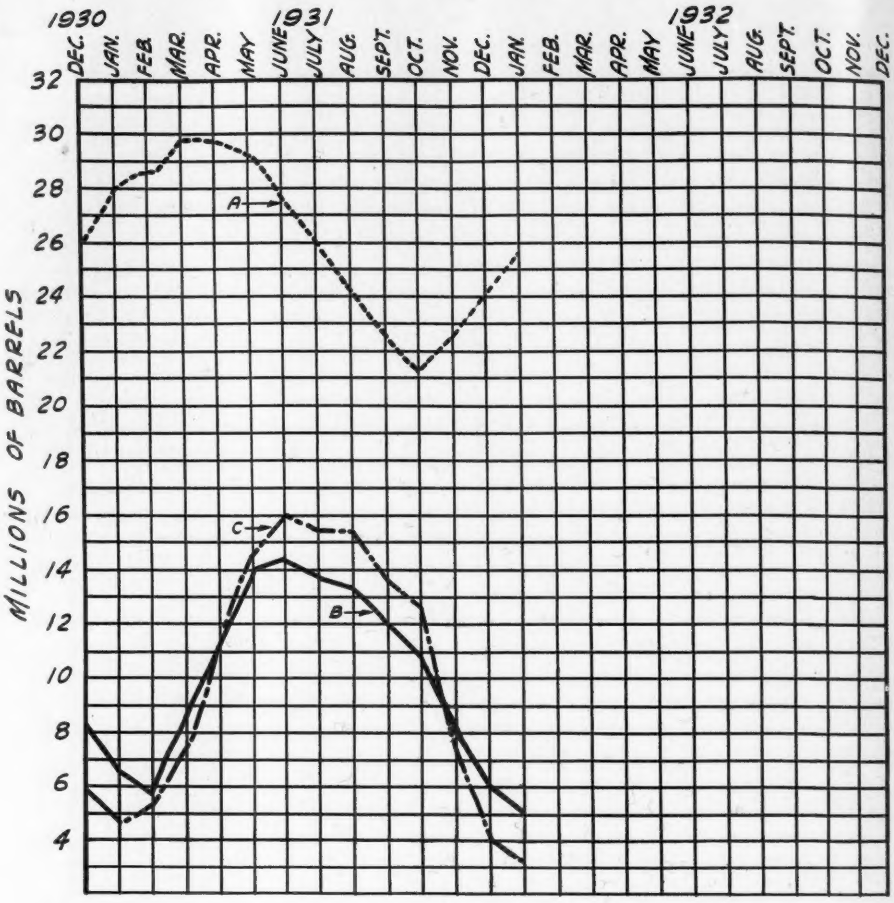
In the following statement of relation of production to capacity the total output of finished cement is compared with the estimated capacity of 165 plants both at the close of January, 1932, and of January, 1931. The estimates include increased capacity due to extensions and improvements during the period.

RELATION OF PRODUCTION TO CAPACITY

	Jan. 1931 Pct.	Jan. 1932 Pct.	Dec. 1931 Pct.	Nov. 1931 Pct.	Oct. 1931 Pct.
The month	29.5	22.0	26.4	37.2	47.4
12 months ended	60.6	45.9	46.5	44.4	48.6

Distribution of Cement

The following figures show shipments from portland cement mills distributed among the states to which cement was shipped during November and December, 1930 and 1931.



(A) Stocks of finished portland cement at factories; (B) Production of finished portland cement; (C) Shipments of finished portland cement from factories

PORTLAND CEMENT SHIPPED FROM MILLS INTO STATES IN NOVEMBER AND DECEMBER, 1930 AND 1931, IN BARRELS*

Shipped to	1930—November	—1931	1930—December	—1931
Alabama	67,219	26,734	77,946	21,963
Alaska	158	1,639	142	25
Arizona	31,593	17,011	30,171	15,640
Arkansas	89,411	34,693	63,553	17,112
California	665,028	470,754	704,699	322,270
Colorado	41,748	38,404	19,474	22,047
Connecticut	113,957	115,800	68,997	51,564
Delaware	17,889	18,229	12,883	11,461
District of Columbia	84,931	95,710	59,861	77,875
Florida	74,271	37,769	60,233	33,081
Georgia	103,952	128,392	86,898	83,222
Hawaii	17,979	21,519	19,770	12,473
Idaho	13,538	9,077	4,829	3,286
Illinois	655,302	406,836	247,845	193,244
Indiana	160,458	138,043	80,190	72,495
Iowa	98,047	75,393	40,965	34,916
Kansas	153,458	85,981	78,186	86,455
Kentucky	102,299	90,891	54,631	49,417
Louisiana	133,845	260,677	130,600	77,914
Maine	53.127	24,292	26.759	11,145
Maryland	119,436	198,975	84,223	133,256
Massachusetts	248,481	230,690	153,583	110,738
Michigan	407,866	191,760	194,610	119,925
Minnesota	89,729	91,214	64,412	35,166
Mississippi	34,044	15,557	32,986	5,820
Missouri	413,025	213,618	188,762	178,052
Montana	20,597	9,559	9,612	3,697
Nebraska	68,717	51,826	21,890	25,655
Nevada	6,681	14,780	1,916	12.587
New Hampshire	24,958	30,307	12,673	9,272
New Jersey	403,664	398,550	259,936	212,095
New Mexico	17,445	11,949	12,929	9,934
New York	1,233,534	1,227,819	867,187	760,928
North Carolina	63,911	55,078	42,274	35,452
North Dakota	7,734	6,173	2,352	1,258
Ohio	614,013	372,879	238,538	194,959
Oklahoma	195,644	124,304	135,784	121,420
Oregon	87,098	52,811	53,936	16,332
Pennsylvania	517,568	528,285	431,241	298,610
Porto Rico	125	9,270	6,918	8,525
Rhode Island	34,865	35,781	20,270	26,601
South Carolina	177,632	166,201	132,992	52,483
South Dakota	17,948	14,229	7,187	8,749
Tennessee	117,871	95,367	74,077	44,322
Texas	454,199	369,500	339,964	223,504
Utah	21,142	12,905	4,271	6,861
Vermont	21,939	15,769	2,678	5,602
Virginia	102,029	117,236	77,370	78,200
Washington	262,159	71,393	185,135	50,654
West Virginia	105,304	83,551	56,245	50,176
Wisconsin	157,633	153,691	62,793	73,102
Wyoming	8,763	4,908	3,028	2,661
Unspecified	13,633	53,609	427	0
	8,747,597	7,127,388	5,650,831	4,114,201
Foreign countries	36,403	28,612	37,169	27,799
Total shipped from cement plants	8,784,000	7,156,000	5,688,000	4,142,000

*Includes estimated distribution of shipments from three plants in November and December, 1931; from two plants in November and December, 1930.

PRODUCTION AND STOCKS OF CLINKER BY MONTHS, IN 1931 AND 1932, IN BARRELS

Month	1931—Production	—1932	Stocks at end of month 1931	Stocks at end of month 1932
January	8,129,000	6,107,000	10,384,000	8,142,000
February	7,473,000	....	11,946,000	....
March	9,586,000	....	13,318,000	....
April	11,540,000	....	13,854,000	....
May	13,159,000	....	13,087,000	....
June	12,679,000	....	11,837,000	....
July	12,246,000	....	10,209,000	....
August	11,664,000	....	8,468,000	....
September	10,414,000	....	6,918,000	....
October	9,825,000	....	6,021,000	....
November	8,259,000	....	6,215,000	....
December	6,840,000	....	*6,973,000	....

*Revised.

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT, BY DISTRICTS, IN JANUARY, 1931 AND 1932, AND STOCKS IN DECEMBER, 1931, IN BARRELS

District	Production 1931—Jan.	Production 1932	Shipments 1931—Jan.	Shipments 1932	Stocks at end of month 1931	Stocks at end of month 1932	Stocks at end of Dec., 1931*
Eastern Penn., N. J., Md.	1,617,000	1,511,000	1,084,000	1,073,000	5,546,000	5,212,000	4,774,000
New York and Maine	420,000	279,000	206,000	199,000	1,988,000	1,423,000	1,343,000
Ohio, Western Penn., W. Va.	504,000	246,000	367,000	239,000	3,709,000	3,477,000	3,470,000
Michigan	45,000	164,000	220,000	121,000	2,915,000	2,099,000	2,057,000
Wis., Ill., Ind. & Ky.	804,000	540,000	354,000	237,000	3,955,000	3,120,000	2,817,000
Va., Tenn., Ala., Ga., Fla., La.	646,000	425,000	679,000	404,000	1,766,000	1,817,000	1,796,000
East'n Mo., Ia., Minn., S.D.	854,000	534,000	288,000	142,000	3,069,000	823,000	3,098,000
West'n Mo., Nebraska, Kansas, Oklahoma and Arkansas	450,000	530,000	321,000	194,000	2,218,000	1,817,000	1,481,000
Texas	322,000	338,000	340,000	241,000	782,000	823,000	726,000
Colo., Mont., Utah., Wyo., Ida.	123,000	39,000	50,000	33,000	410,000	486,000	480,000
California	624,000	336,000	643,000	413,000	831,000	1,154,000	1,231,000
Oregon and Washington	186,000	47,000	140.000	67,000	570,000	640,000	669,000
	6,595,000	4,989,000	4,692,000	3,363,000	27,759,000	25,568,000	23,942,000

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT, BY MONTHS, IN 1931 AND 1932, IN BARRELS

Month	1931—Production	1932	1931—Shipments	1932	Stocks at end of month 1931	1932
January	6,595,000	4,989,000	4,692,000	3,363,000	27,759,000	25,568,000
February	5,920,000	....	5,074,000	....	28,612,000	....
March	8,245,000	....	7,192,000	....	29,676,000	....
April	11,245,000	....	11,184,000	....	29,715,000	....
May	14,010,000	....	14,200,000	....	29,554,000	....
June	14,118,000	....	16,077,000	....	27,602,000	....
July	13,899,000	....	15,545,000	....	25,934,000	....
August	13,549,000	....	15,172,000	....	24,313,000	....
September	12,092,000	....	13,671,000	....	22,736,000	....
October	10,762,000	....	12,360,000	....	21,218,000	....
November	8,161,000	....	7,156,000	....	22,219,000	....
December	*5,974,000	....	4,142,000	....	*23,942,000	....
	*124,570,000	....	126,465,000	....	....	....

PRODUCTION AND STOCKS OF CLINKER (UNGROUND CEMENT), BY DISTRICTS, IN JANUARY, 1931 AND 1932, IN BARRELS

District	1931—Production	1932	Stocks at end of month 1931	1932
Eastern Pennsylvania, New Jersey and Maryland	1,878,000	1,599,000	1,329,000	909,000
New York and Maine	659,000	467,000	902,000	596,000
Ohio, Western Pennsylvania and West Virginia	724,000	454,000	1,290,000	895,000
Michigan	445,000	253,000	1,271,000	731,000
Wisconsin, Illinois, Indiana and Kentucky	1,000,000	758,000	1,091,000	719,000
Virginia, Tennessee, Alabama, Georgia, Florida, Louisiana	587,000	512,000	966,000	790,000
Eastern Missouri, Iowa, Minnesota and South Dakota	898,000	531,000	584,000	456,000
Western Missouri, Nebraska, Kansas, Oklahoma, Arkansas	550,000	693,000	666,000	643,000
Texas	315,000	284,000	339,000	295,000
Colorado, Montana, Utah, Wyoming and Idaho	128,000	73,000	276,000	162,000
California	686,000	448,000	1,175,000	1,545,000
Oregon and Washington	259,000	35,000	495,000	401,000
	8,129,000	6,107,000	10,384,000	8,142,000

EXPORTS AND IMPORTS OF HYDRAULIC CEMENT, BY MONTHS, IN 1930 AND 1931‡

Month	1930—Exports Barrels	Value	1931 Barrels	Value	1930—Imports§ Barrels	Value	1931 Barrels	Value
January	82,387	$ 293,135	41,199	$ 115,678	201,609	$ 207,461	95,609	$120,298
February	64,267	217,798	25,703	88,989	114,455	119,717	21,984	25,391
March	117,563	357,896	54,599	144,579	43,622	59,981	70,378	80,360
April	57,419	200,217	40,478	116,564	140,871	178,226	53,333	58,576
May	57,423	198,170	48,028	140,953	94,696	111,998	19,325	20,568
June	82,077	223,639	43,597	107,610	55,356	74,370	32,079	42,955
July	47,082	166,577	29,344	97,837	12,404	20,973	14,332	15,582
August	49,031	167,579	39,517	106,643	35,323	39,029	8,895	11,739
September	46,664	153,384	27,570	81,399	51,096	59,721	33,574	33,520
October	62,690	190,305	24,531	68,524	75,284	84,364	39,642	42,380
November	50,495	151,555	33,200	97,796	109,124	125,448	27,940	22,235
December	38,680	134,260	21,887	54,028	44,157	59,641	40,147	34,314
	755,778	$2,454,515	429,653	$1,220,600	977,997	$1,140,929	457,238	$507,918

Exports and Imports†*

Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

EXPORTS OF HYDRAULIC CEMENT BY COUNTRIES IN DECEMBER, 1931

Exported to	Barrels	Value
Canada	686	$ 2,288
Central America	11,348	18,478
Cuba	702	1,819
Other West Indies and Bermuda	1,669	3,088
Mexico	1,437	4,416
South America	4,979	18,579
Other countries	1,066	5,360
	21,887	$54,028

IMPORTS OF HYDRAULIC CEMENT BY COUNTRIES AND BY DISTRICTS, IN DECEMBER, 1931

Imported from	District into which imported	Barrels	Value
Canada	Maine and New Hampshire	32	$ 85
Cuba	Porto Rico	1,136	1,688
Denmark	Porto Rico	11,630	8,796
Japan	Hawaii	1,979	2,341
United K'gd'm.	Florida	609	$ 863
	New York	24,761	20,541
	Total	25,370	$21,404
	Grand total	40,147	$34,314

DOMESTIC HYDRAULIC CEMENT SHIPPED TO ALASKA, HAWAII AND PORTO RICO IN DECEMBER, 1931

	Barrels	Value
Alaska	1,698	$ 3,655
Hawaii	23,206	54,596
Porto Rico	8,735	11,751
	33,639	$70,002

*The value of exports of domestic cement is the actual cost at the time of exportation in the ports of the United States whence they are exported, as declared by the shippers on the export declarations.

†The value of imported cement represents the foreign market value at the time of exportation to the United States.

‡Revised.

§Includes hydraulic cement clinker and white nonstaining portland cement.

North Carolina Contracts for Cement for Two Years

CEMENT to cost approximately $4,000,000, if Congress enacts legislation for emergency road building, was contracted for by North Carolina, February 4.

The cement contract, being the estimated quantity for the next two years, was awarded to eight companies, for 200,000 bbl. each.

Illinois Contracts for State Highway Cement

RECENTLY the Division of Highways of the Department of Public Works and Buildings, State of Illinois, let contracts for portland cement requirements for 1932. Individual bids were asked for delivery in each of the 102 counties of the state. A general analysis of these bids indicates that the net mill price of the most successful bidder ranges from about 38 c. to 54 c. per bbl., with an average of 46 c., exclusive of freight, the 40 c. sack charge and the 10 c. per bbl. discount for cash.

Contracts were let for the purchase of 4,105,000 bbl. The cement was contracted at an average delivered price of $1.44 per bbl. On this quantity the cost is $1,395,700 less than at the prices prevailing in 1931.

The Department of Public Works has the right under its contracts to purchase an additional 25% at the same prices, which would enable the department to secure another million barrels at these same low figures which, if shipped, would increase the saving to the department to $1,744,625 over 1931 prices.

Seventy-eight per cent. of this cement will be manufactured by Illinois mills, and the remaining 22% will be supplied by mills closely bordering Illinois which are using Illinois coal and other products in their manufacturing process.

The amount of cement to be awarded to the low bidders is as follows

Company, location of mi'l	Quantity, bbl.
Marquette Cement Manufacturing Co., Oglesby	2,500,000
Dewey Portland Cement Co., Davenport, Ia.	166,000
Missouri Portland Cement Co., St. Louis, Mo.	139,000
Alpha Portland Cement Co., LaSal'e, Mo.	700,000
Alpha Portland Cement Co., St. Louis, Mo.	600,000
Total	4,105,000

Considers Dividing Cement Contract Among All Bidders

THE Cook County, Ill., commissioners have invited representatives of five cement companies, bidders on a $1,000,000 contract for county road cement requirements, to appear before the board and consider splitting the sale among them. It was suggested by Commissioner Charles Weber, who said it would be good practice in view of business conditions to divide the contract among all the companies, provided they would agree to the price of the low bidder.

The Marquette Cement Manufacturing Co., Chicago, Ill., was low bidder by 6c. a bbl. The other bidders are the Universal Atlas Cement Co., the Lehigh Portland Cement Co., the Medusa Portland Cement Co., and the Alpha Portland Cement Co.—*Chicago* (Ill.) *Tribune.*

Mining Engineers Discuss Nonmetallics

Many Papers on Rock Products Read at Annual Meeting of American Institute of Mining and Metallurgical Engineers

(By a Special Correspondent)

AS A FITTING TRIBUTE to his many years of experience in the mining industry, Scott Turner, director, United States Bureau of Mines, was elected president of the American Institute of Mining and Metallurgical Engineers at the annual meeting of the Institute held in New York City from February 15 to 18. Among other features of the program was the unveiling of a portrait of Herbert Hoover, a past-president of A. I. M. E.; a lecture by Dr. Fred Allison on the detection of elements 85 and 87; and the annual Howe lecture presented this year by E. C. Bain.

Nonmetallic minerals occupied an important position on the program. Two sessions on Wednesday, February 17, comprising 11 papers, were devoted entirely to nonmetallics, while several papers presented at other times are of interest to the nonmetallics industry.

Explosive Shattering of Minerals

In the Monday afternoon session on Milling Methods the paper[1] by R. S. Dean and John Gross on the explosive shattering of minerals attracted considerable attention. The authors summarize their investigation as follows:

> The principle of explosive crushing depends upon the fact that an expandable substance contained within the pores of a solid body will disrupt such a body upon expansion. Such expansion may be obtained by the detonation of an explosive or by the sudden release of pressure of a superheated liquid.
>
> That this principle of disruption may be applied to minerals rests on the fact that cracks, cleavage planes, and pores exist in all minerals to an extent hardly conceived possible heretofore.
>
> Crushing by this method takes advantage of forces applied from within the mineral rather than from forces applied from without. The application of a force from within would appear to be more effective.
>
> A consideration of the possibilities of such a method for crushing led to some experimental work of a preliminary nature, the results of which are embodied in this paper. No systematic program was followed in the work and the results are, therefore, not final and far from complete.
>
> The success attained, so far, with the mediocre apparatus available seems to warrant a preliminary report, with the expressed hope that the work may be carried on as a well-outlined program covering such phases as have been impossible to investigate at this time.

Scott Turner, Director of the United States Bureau of Mines

In the ensuing discussion it was pointed out that theoretically the explosive shattering process depends on surface exposed. Therefore, it should be more efficient for fine sizes than for large, and as a result, more economical than present methods in which costs increase rapidly with diminution of size.

H. Hardinge added an interesting comment when he expressed an opinion that grinding processes may be completely revolutionized within the next few years. He added, however, that explosive shattering may or may not be the ultimate solution of the problem.

Efficiency of Crushing

John Gross presented the results of ball mill grinding tests being conducted at the Intermountain Station of the Bureau of Mines. The effects of variability of mill speed, pulp densities, ball size, ball weights and quartz charge are being investigated. In the discussion it was pointed out that results for batch grinding may vary from those for continuous grinding and that the study logically should be enlarged to include a thorough consideration of both methods. The final results of this investigation no doubt will be published later by the Bureau of Mines.

Relation of Fineness to Mill Capacity

A. H. Fahrenwald next presented some data showing the relation of fineness of grinding to mill capacities. His paper summarized the relative importance of fineness, power, and time as applied to grinding processes. In the ensuing discussion, the question of wetting the material for higher efficiency in ball mill grinding was raised, but in Mr. Fahrenwald's opinion it is unanswerable because of conflicting data. This paper is available at present only as a mimeographed preprint.

Sampling by Hammer Drills

Tuesday morning at the Mining Methods session, J. B. Knaebel presented an interesting paper[2] on sampling by hammer drills.

He stated that many mine operators are using as ore samples, cuttings obtained by hammer drills, and that similar equipment has been used successfully for exploratory work to depths as great as 250 ft. This procedure might be applicable to nonmetallics in sampling or in computing reserves in high grade limestone or similar deposits, especially those occurring in lenticular masses.

The discussion of the paper dealt primarily with the relative importance of cuttings and sludge in obtaining a true sample, and in most nonmetallic deposits the particle size would be of little consequence.

Personnel Problems

C. W. Wright in a discussion of labor problems pointed out the necessity for careful selection of proper men for all jobs, regardless of their importance. Efficient placement of men returns dividends to the operator.

In many metal mines a bonus system with a guaranteed base wage has resulted in lowered unit costs. Much grief is due to poor management. Success depends on labor, and the efficiency of labor depends directly upon management.

The morale of employes should not be ignored. Loyalty may be stimulated by welfare work, upkeep of playgrounds and athletic facilities, sponsoring of movies,

[1] Dean, R. S., and Gross, John, "Explosive Shattering of Minerals as a Substitute for Crushing Preparatory to Ore Dressing," U. S. Bureau of Mines, R. I. 3118, February, 1932, 5 pp.

[2] Knaebel, J. B., "Sampling and Exploration by Means of Hammer Drills," U. S. Bureau of Mines I. C. 6594, February, 1932, 31 pp.

or the awarding of prizes for gardens, lawns, and the like. Contrary to the present belief of many operators, these practices need not be confined to company towns.

Every company, both large and small, should ever strive for improved morale and decreased costs. In many instances the two go hand in hand, but an especial effort should be made to investigate any potential cost saving which might result from revision of pay systems.

Room and Pillar Mining

The importance of room and pillar mining in nonmetallics was pointed out by J. R. Thoenen, who stated that in 1928, 169 room and pillar mines produced nonmetallic minerals, including limestone, salt, gypsum and clay. The following is taken from Mr. Thoenen's own abstract of his presentation:

Room-and-pillar methods have been used in mining nonmetallic minerals since early Egyptian times. In this country limestone has been the principal material mined by these methods, dating since 1883.

The principal materials mined by these methods are limestone, rock salt, gypsum and clay. Sixteen and one-half million tons of these materials were produced by room-and-pillar methods in 1929. In recent years the operating costs of such operations have been materially reduced, due probably to the greater attention paid nonmetallics by mining engineers.

The strength and structure of the overlying stratum has an important bearing on the size and width of rooms and pillars.

Methods of stoping vary considerably, ranging from simple irregular breast stoping in one lift to combinations of breast and underhand or back stoping in two or more benches.

In the harder materials customary metal-mine equipment and methods are employed in drilling, while in the softer minerals coal-mine practice and equipment are common.

Some mines continue to employ hand loading principally because of the necessity for selective mining, either as to quality or size of material. The greater number of these operations, however, employ some form of power shovel loading, with shovels ranging from ½ to 2-yd. dippers.

In hauling material from working face to shaft or surface there is no attempt at standardization of equipment. Nearly every mine has a different type of rolling stock representing peculiar local requirements or the personal preference of the operator. All types of locomotives are used, ranging from small coal-burning dinkeys to modern trolley or storage battery types.

The usual large cross-section of rooms operates to provide good natural ventilation and few installations of mechanical ventilation have been found necessary.

A typical example of underground mining costs by room-and-pillar methods in limestone may be cited as follows:

	Per ton
Drilling	$0.122
Loading	0.104
Blasting	0.102
Hauling	0.114
Overhead	0.151
Total	$0.593

Nonmetallic Minerals Sessions

The morning session of the program prepared by the Committee on Nonmetallic Minerals was devoted to beneficiation of nonmetallics and was presided over by W. M. Weigel, chairman of the committee. The papers presented at the afternoon session were of a more general nature and the speakers were introduced by W. M. Myers, vice-chairman. Attendance during the day fluctuated considerably, but at mid-morning a peak of about 65 was reached. This interest in nonmetallics is gratifying, and it indicates that the work of the Institute in this field is becoming increasingly important.

Mineral Wool

In the absence of the author, W. N. Logan, state geologist of Indiana, the first paper[3] of the morning on mineral wool was presented in abstract by H. H. Hughes. Mr. Logan points out that the supplies of raw materials available in Indiana for mineral wool manufacture are virtually inexhaustible but he cautions the prospective operator as follows:

However, in both areas the raw materials occur under more favorable stratigraphic conditions in some localities than in others and thus in the selection of a factory site the choice will depend upon factors other than that of quantity of materials. In such selection consideration should be given to the thickness and the character of the overburden, the thickness of the wool rock, the presence of suitable flux, the composition of wool rock and flux, site for factory, water supply, transportation facilities and other factors.

After describing briefly the character of the wool rock and outlining methods of quarrying and manufacture, Logan discusses the fuel and heat requirements. He states that:

The total amount of heat required to fuse rock wool depends upon the chemical composition and the physical structure of the raw materials, upon the type of fuel used, the method of applying the heat, the method of placing the materials in the cupola, the rate at which the heat is applied and the moisture content of the raw materials. Slag may be produced at temperatures ranging from 2500 deg. to 3800 deg. F. The former temperature may be sufficient under the most favorable condition, while the latter is well above the average.

Failures to produce slag may be due to too large an amount of magnesium and calcium carbonates in the raw materials, so that lime instead of slag is produced. On the other hand, the raw materials may contain too much aluminum silicate in proportion to the fluxing constituents and no slag may result. A careful chemical examination of raw materials is essential to the successful production of slag.

Soap Flotation

The next paper[4] by W. H. Coghill and J. B. Clemmer on soap flotation of the non-sulfides aroused considerable interest. It was presented by Mr. Coghill who explained that in early attempts to float hematite it was found that instead the calcite and limestone were separated. This led to experiments with other nonmetallic minerals, and shortly thereafter a plant was installed in Florida to float phosphate rock.

Later, fluorspar was treated successfully in the Illinois-Kentucky district and rhodochrosite at Butte, Mont. Barite can be cleaned nicely, and by crushing to flotation size, the iron coating which commonly is associated with barite can be removed. Table concentration of kyanite has been only moderately successful, but flotation cleans up kyanite and quartz.

Mr. Coghill pointed out that the process may be applied to a wider range of materials in the nonmetallic group than in the sulfide, and that it is reasonable to expect broad commercial utilization of the process in the future.

S. H. Dolbear stated that he had floated asbestos successfully with soap, about 50% having been recovered and most of the rest could be brought over by the use of pine oil. He added, however, that the procedure was not likely to prove commercially feasible because of the necessary fine state of subdivision.

In reply to a question by O. Anderson, Mr. Coghill stated that he believes it possible to separate feldspar from a gangue consisting essentially of quartz. John Gross added that some work on the problems already had been done at Salt Lake. B. C. Burgess stated that he was of the opinion that pegmatites are not being exhausted rapidly, and therefore, flotation of feldspar is only of remote interest to the feldspar industry at present.

C. Q. Payne asked about the cost of reagents and Mr. Coghill estimated that 10 to 15c a ton would be the average. He added in reply to Mr. McCoy that the froth to be of proper consistency should break freely. E. Thomas then asked how to define a froth to which Mr. Coghill replied that it was "an accumulation of bubbles that break down freely." S. H. Dolbear added a humorous strain when he told of his experience in a patent case where a froth was defined as an aggregate of three or more bubbles.

Coghill and Clemmer conclude their paper with a summarization of the problem as follows:

Intermittently the study of soap flotation of nonsulfide ores has been in progress in the Bureau of Mines since 1925. In terms of number of ores, nonsulfide flotation is more important than sulfide flotation. Though incomplete, the investigation has included 14 "ores": limestone, phosphate rock, bauxite, fluorspar, rhodochrosite, manganese oxides, barite, siderite, chromite, scheelite, ferberite, cyanite, beryl, and spodumene. Of these, four have been put through successful trials in commercial flotation plants; i.e., phosphate rock, fluorspar, rhodochrosite,

[3] Logan, W. N., "The Mineral Wool Industry in Indiana," A. I. M. E. Preprint, 10 pp.

[4] Coghill, W. H., and Clemmer, J. B., "Soap Flotation of the Nonsulfides," A. I. M. E. Technical Publication, No. 445, February, 1932, 18 pp.

and manganese oxides. Laboratory tests indicate that some of the other ores mentioned are equally amenable.

The work has been done under a cooperative agreement between the Mississippi Valley Experiment Station of the United States Bureau of Mines and the Missouri School of Mines and Metallurgy, Rolla, Missouri, and between the Southern Experiment Station of the United States Bureau of Mines and the University of Alabama, Tuscaloosa, Ala.

The flotation of such ores depends on the proper selection and amounts of pine oil, sodium oleate, oleic acid, sodium carbonate, sodium hydrate, sodium silicate and similar reagents. That sulfuric acid has to be added to this list of alkalies seems an anomaly, but repeated tests have shown that some of the ores require a little sulfuric acid in the cleaning treatment. Generally less than 100 parts of any one of the reagents in 1,000,000 parts of water is sufficient. A slight excess is likely to destroy flotation.

Often the worker may be guided by phenomena instantly observable to the naked eye; and observations throughout the work lend justification to the belief that the principles of flotation are epitomized in the "flocculation of the mineral and dispersion of the gangue."

Magnetic Separation

S. G. Frantz and G. W. Jarman, Jr., described the development and commercial possibilities of magnetic separation, especially as applied to nonmetallics. The paper[5] was presented by Mr. Jarman. He traced the results obtained by the Exolon Co. during their preliminary investigations; the iron content of their product being reduced from 0.08% to 0.02%, and finally to 0.001%.

The process as applied to feldspar beneficiation has been described in U. S. Bureau of Mines Information Circular 6488, as follows:

The Johnson separators are of the electromagnetic induction type. Each machine has two large coils, an upper coil with three pole pieces at each end, and a lower coil with two pole pieces at each end. A laminated rotor, 30 in. long, revolves under each of these pole pieces. A special device feeds a thin uniform stream of the sized spar over the length of each rotor. As the material passes from one rotor to the next, all magnetic particles are deflected by the rotors, permitting the feldspar to continue on through five successive cleaning treatments. Each rotor removes a portion of the contaminating minerals, the more highly magnetic being removed by the upper rotors and the feebly magnetic by the lower rotors.

The strength of the magnetic field developed by the Johnson induction separator is phenomenal, and as the separation depends on the deflection of magnetic particles in falling rather than on lifting, astonishing results are obtained, in that minerals even with traces of iron are removed. For example, muscovite without visible iron stain is removed from the spar, which, prepared by this method, consistently contains less than 0.06% of iron, or about one-half of the usual maximum specification for this type of spar.

Similar procedures have been used at least experimentally to lower the ash content in coal; to recover kyanite concentrates, and to separate minerals from beach sands. From an economic standpoint, consideration must be given to the cost of grinding, drying, sizing, and of power, although the cost of electricity for the separation itself may be as low as ⅓c. per ton.

During the discussion of the paper F. A. Jordan, E. Thomas, F. W. Lee, C. Q. Payne and C. S. Parsons asked several questions which were answered by either Mr. Jarman or Mr. Frantz. Several interesting points were brought out. Material as fine as 200-mesh has been treated successfully, but further research will be necessary to prove the commercial possibilities of the practice; also, particles up to 8-mesh may be separated. The moisture content depends directly on the quantity that any material can contain and still flow freely. The capacity depends on density, susceptibility, and fineness, but the average is between 1 ton and 3½ tons per hour.

The authors predict the future of magnetic separation as follows:

In looking at the future of magnetic separation we should bear in mind that it will be used as it is now being used, sometimes alone as a self-sufficient means and sometimes in conjunction with other methods to accomplish results impossible or uneconomical by any single means. It is reasonable to believe that research both in the design of machines and in their applications will continue in the next five years as rapidly as it has in the last five years and make the magnetic method one of the most important tools in ore dressing.

The use of this new process is of particular interest to the ceramic industry for the removal of faintly iron-stained particles from their bodies. It is also of interest to all producers of nonmetallic materials such as bauxite, coal, fluorspar, kyanite, barite, and the rare earths, etc. It would be well worth while for research engineers to look again into separating problems that have been given up as hopeless.

The magnetic separator is a dry concentrator; it is automatic, it is not dangerous, it is not affected by weather, its operation is simple, its cost per ton is low, and its results are uniform.

The Sillimanite Group

F. H. Riddle introduced his paper[6] on the sillimanite group of minerals by giving two references[7] on the subject. He explained that the commercial development of these minerals was rather unusual in that a use was found for them before deposits of the minerals themselves had been discovered. The present problem, however, is to find new uses in order to increase production. One of the most important uses of these minerals is for spark plug core manufacture; about 300,000,000 spark plugs annually consume andalusite and dumortierite.

Mr. Riddle then called upon Dr. T. S. Curtis, who gave a most interesting extemporaneous talk on the California kyanite deposits of the Vitrefrax Corp. Dr. Curtis described the ore as containing about 35% kyanite fiber, but the composition of the fiber is not exactly that of kyanite itself. The ore has little refractory value. The fiber, however, exudes globules of glass which acts as a binder imparting toughness to the resultant refractories.

The kyanite occurs with quartzite, and, at the critical temperature quartz can be broken down with heating and quenching. As a result of this property, an automatic machine consisting of a rotary kiln and quencher has been devised. This process breaks down the quartz gangue and separation then is effected by a simple screening procedure. Two grades of concentrates are produced. The secret of the process lies in the ease with which free silica can be converted to tridymite.

The higher cost of refractories made from the sillimanite group is more than offset in many instances by their longer life. Dr. Curtis mentioned one example in oil refining practice in California where ordinary refractories with a life of from 3 to 6 months had been replaced by special products made from aluminum silicate, and they are still in use after 5 or 6 years, with no cost for repairs.

J. H. Weiss then asked whether mullite would replace feldspar as ceramic bond. Mr. Riddle replied that although mullite was much stronger because of the nature of its growth, it would not be economical for it to replace feldspar except for highly specialized purposes.

In the discussion contributed in writing, Dr. P. F. Kerr described a deposit near Bishop, Calif., which he visited during the past year. A. F. Greaves-Walker called attention to the possibilities of the North Carolina kyanite deposits. A. B. Peck discussed the relation of the properties of this group of minerals to refractories.

Cost Accounting

The last paper[8] of the morning session, on cost accounting in the crushed stone industry, was presented in abstract by J. R. Thoenen in the absence of the author, W. E. Hilliard. Mr. Thoenen pointed out that this paper was an outgrowth of the work done by the cost accounting committee of the National Crushed Stone Association. Since ROCK PRODUCTS closely follows the activities of this organization, it is not necessary to go into detail regarding this paper.

The afternoon session in nonmetallics was called to order by W. M. Myers, who

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[5] Frantz, S. G., and Jarman, G. W., Jr., "Magnetic Beneficiation of Nonmetallics," A. I. M. E. Preprint, 7 pp.

[6] Riddle, F. H., "Mining and Treatment of the Sillimanite Group of Minerals and Their Use in Ceramic Products," A. I. M. E. Technical Publication, No. 460, February, 1932, 23 pp.

[7] Bole, C. A., "The Alumino-Silicate Refractories, Metals and Alloys," January, 1932, p. 15. California Division of Mines, Mining in California, July, 1931, p. 456.

[8] Hilliard, W. E., "Uniform Cost Accounting in the Crushed Stone Industry," A. I. M. E. Preprint, 9 pp.

then introduced the first speaker, E. R. Lilley. Mr. Lilley's paper[9] describes the geology of kaolin deposits in Germany, Great Britain, and the Czecho-Slovak Republic. These deposits are of three types:

1. The blanket kaolins in the granites and related crystalline rocks of southern Germany and Czecho-Slovakia.
2. The kaolinized arkosic sandstones of Czechoslovakia and Bavaria.
3. The china clay and chinastone in the granite of Cornwall and Devon, England.

Mr. Lilley's principal purpose in presenting this paper was to attract attention to these deposits, or, in his own words:

The writer has endeavored in a brief way to describe three groups of koalin deposits which were of unusual interest to him because of their difference from deposits now being worked in the United States and concerning which very little has appeared in American literature. In discussing the origin of these deposits he has of necessity discussed subjects concerning which there is still more or less controversy. He has limited himself largely to presentation of conclusions that have received general approval and to which he himself could subscribe. He feels that any comparison of the commercial importance of these deposits would be out of place in this paper; each one is of especial importance in its own sphere. However, he would like to bring out one point, a query rather than a conclusion. The differences between the deposits discussed and those worked in the United States, both as regards form and character and as regards origin, lead him to ask whether the absence of such deposits in this country is not more apparent than real, and to wonder if in the light of European experience this country has really made a thorough survey of its possibilities as a producer of high-grade kaolins.

In the discussion, primarily between Dr. H. Reis and Mr. Lilley, the controversy between the clay operators and the owners of the Carlsbad Springs was brought out. The officials of the Springs company are fearful lest the clay pits destroy or impair their source of livelihood. Dr. Reis also expressed the opinion that the superiority of many foreign kaolins over domestic may be due to methods of preparation rather than any inherent value of the deposits.

Indiana Limestone

J. B. Newsom's paper[10] on quarry waste in Indiana limestone quarrying was most interesting. If all nonmetallics operators had as clear a picture of their operating processes as the Indiana limestone producers, no doubt the possibilities of appreciable savings would be evident.

Mr. Newsom analyzes the situation as follows:

In the Indiana limestone district, some 50 or 60% of the merchantable stone in a quarry opening is waste, and only about 40 or 50% of the stone from the opening is finally sold. So long as the present system of quarrying is used, the wastes measured and reported in this paper will continue. Comprehensive development of an entirely different method of quarrying, using wire saws for cutting, promises great improvement. Some of the savings to be expected are pointed out in the following pages. No attempt has been made to measure losses due to variations and natural flaws in the stone, since these vary greatly in different quarries, and accurate measurement would be difficult. The wastes that have been measured account for about 30% of the total ledge, which leaves 20 or 30% chargeable to unmeasured sources of loss.

There are four general reasons for quarry waste: (1) the structure of the deposit, such as its shape, bedding planes, solution cavities and strain fractures; (2) efforts to quarry blocks which do not contain distinct color or textural variations; (3) the trade custom which permits purchasers to specify the size of the quarry blocks which they will buy, which is a matter of competition for business on the part of stone producers; (4) quarry methods, which cause the greatest amount of waste. Wide channeler cuts, hook holes, crooked splitting and uneven breaking on quarry floors are included in this category.

In concluding his paper, Mr. Newsom summarizes the quarry losses as shown in the accompanying table and discussion:

Considered separately, the figures given tend to be confusing. A better appreciation of their significance will be gained from a study of Table 1, which is constructed by working from the quarry production, although this makes the figures lower than they would be if all the sources of waste could be measured and included. To illustrate, the channeler loss indicated applies only to the stone actually produced. The channeler loss incurred in producing stone which was damaged in some later process, such as in splitting cuts down to quarry block size, is not shown. If the total quarry loss is assumed to average 50 per cent. channeler loss should be 82,600 ft. instead of the 59,450 ft. shown. The other losses also would be proportionately larger. However, these figures are accurate enough to indicate which causes of quarry loss are at present the most serious. Applying them to the 1930 production, we find a total loss of 4,200,000 cu. ft., worth about $2,050,000.

TABLE 1. MEASURED QUARRY WASTE*

	Cu. ft.
Cut by channelers	59,450
Lost by crooked channels	69,270
Bottom-break loss	86,200
Lost splitting to mill-block size	151,050
Dog-hole loss	17,840
Loss due to measuring short	55,950
Finished stone	1,000,000

Total measured loss, 439,760 cu. ft. out of a total of 1,439,760 cu. ft., or 30.5%.

Wire saws have not yet been used in Indiana to a sufficient extent to fully capitalize their advantages. When they are so applied, the savings described will be realized. This will mean that the loss due to the method of quarrying will be cut to about 20% instead of the 30.5% shown in the table. The stone thus saved would have been worth $720,000 in 1930.

Wire Saw Operation

Mr. Newsom followed his first paper[11] with a second devoted to the results of some experimental work with the wire saw as compared with results by channeling. Wire saw costs appear very favorable in comparison with channeling costs. In fact, with a little more experience, Mr. Newsom believes not only that costs per cubic foot will be cut to about half, but also that a considerable percentage of present waste will be eliminated. The continuation of these tests will be interesting to watch, because preliminary evidence indicates that the ultimate results will cause changes as revolutionary as those undergone in the slate industry during the past few years.

U. S. Potash Exploration

Dr. W. T. Schaller gave an interesting account of the geology and mineralogy of the potash beds of southeastern New Mexico. The principal deposit located thus far is about 20 miles due east of Carlsbad. The product now being mined by the United States Potash Co. is a fairly homogeneous mixture of potassium chloride and sodium chloride. It is ground to 6-mesh fineness at the mill and trucked 20 miles to the railroad at Carlsbad.

Following his own paper, Dr. Schaller read a manuscript by G. R. Mansfield which discussed the part played by the U. S. Geological Survey in the potash exploration. Thousands of qualitative, quantitative and petrographic studies have been made by the survey. The five-year program of the Government has stimulated private interest; it has uncovered enormous reserves, and it has established one commercial operation. Additional deposits may be found, but it is believed that other potash sources will not equal those of southeastern New Mexico.

J. H. Hedges then gave an interesting account of the actual administration of the drilling program. The excellent core recovery obtained in the Government wells far surpasses any results heretofore known in diamond drilling in similar strata.

Molding Sand

In the final paper of the afternoon, D. W. Trainer, Jr., presented a geological description of the various types of molding sand deposits; including lake deposits, river deposits, glacial deposits, wind-blown deposits and residual and colluvial deposits. Lack of time prevented discussion.

The consensus of opinion of those attending the nonmetallics sessions seemed to be that the program was one of the best ever arranged by the committee. The interest shown indicates that nonmetallic minerals will be of increasing importance at subsequent meetings of the American Institute of Mining and Metallurgical Engineers.

[9] Lilley, E. R., "The Geology of Some Kaolins of Western Europe," A. I. M. E. Technical Publication, No. 475, February, 1932, 22 pp.

[10] Newsom, J. B., "Quarry Waste in the Indiana Limestone District," A. I. M. E. Technical Publication, No. 444, February, 1932, 10 pp.

*Figures apply only to the waste on the stone actually produced. Work done on stone spoiled in process is not included in this table.

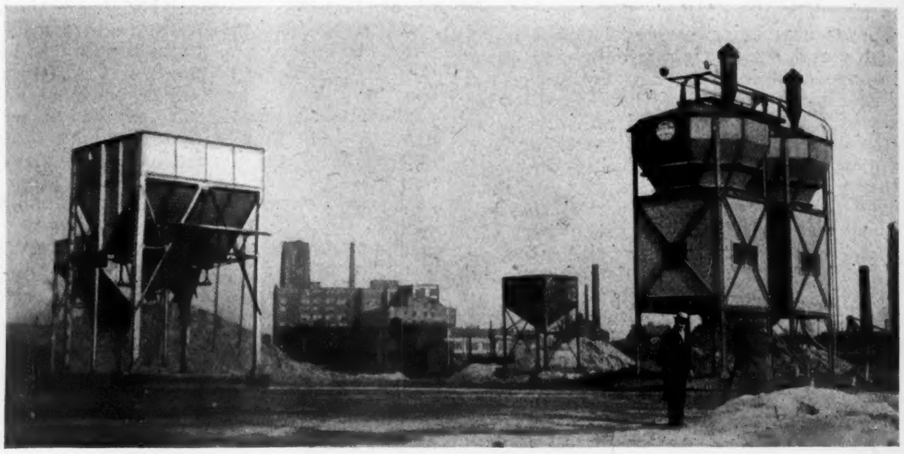
Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

Latest in Batching Plants

Installed by Moulding-Brownell Corporation, Chicago, Ill., Primarily for Construction of New Post Office Building

FOLLOWING the award of the contract for the aggregates and portland cement for Chicago's new $22,000,000 post office building to the Moulding-Brownell Corp., Chicago, Ill., that company erected a dry batching plant at its distribution yard located at 26th and Eleanor streets, on the near south side of metropolitan Chicago. Here the aggregates and portland cement are dry-batched and trucked to the concrete mixers located at the construction site. Approximately 150,000 yd. of concrete remains to be poured out of a total of 200,000 yd. The haul from the yard to the site is roughly 2½ miles.



General view of batching plant

The new post office is a notable engineering undertaking, and when finished will be the largest of its type in the world. According to reports, it will have a floor area of 2,200,000 sq. ft. It will be 12 stories in height. The building will be approximately 800 ft. long, 345 ft. wide and 200 ft. high, and will be bounded by West Harrison, South Canal and West Van Buren streets. It will span the tracks leading into the Chicago Union Station, and will be built on "air rights" purchased from the railroads.

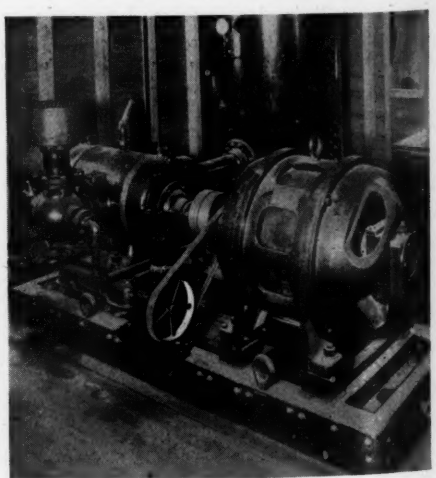
Batching Plant

At 26th and Eleanor streets the Moulding-Brownell Corp. has a large distribution yard for the handling of sand, gravel and crushed stone. These materials can be delivered to the yard by rail or by barge shipments, as the site is bounded on one side by the Chicago river. The aggregate materials are stored in open piles and by means of two Link-Belt cranes with clamshell buckets are loaded to several Butler bins provided with hand-operated dry batchers. Four batchers are used for the sand and the same number for the coarse aggregate. All are volumetric batchers. The method of operation consists in first loading the dump trucks with the required amount of crushed stone and torpedo sand from the volumetric batchers and then moving to the new cement batcher, where the weighed cement is added.

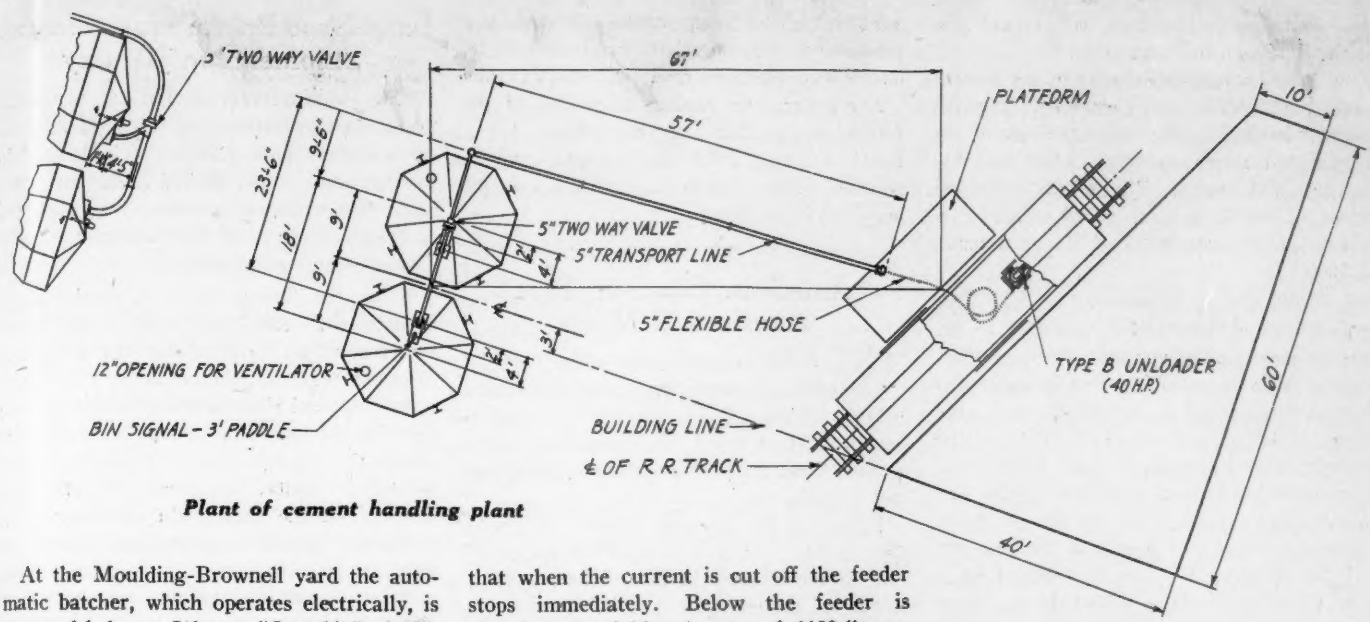
Pneumatic unloader which removes cement from car

This method is satisfactory for handling the sand, gravel and crushed stone aggregates, but when this job was secured it was decided to install the most modern automatic equipment to handle the large volume of portland cement that would be needed. Hence the company installed a Fuller automatic batcher of 1100-lb. capacity and a complete layout for handling bulk cement. A hand-operated Johnson batcher is also available as an auxiliary batching unit. As the Fuller batcher is comparatively new, there being only one or two installations in the field to date, its operation will be described in some detail.

The Fuller Co. has been supplying bulk cement handling equipment for a number of years, particularly the Fuller-Kinyon pump, rotary air compressor, rotary feeder and rotary gate valve, to the portland cement and the ready-mixed concrete industry. In order to make the line of batching equipment complete it remained only to design an automatic weighing device for the cement, which has recently been done.



Rotary compressor which supplies air for handling cement

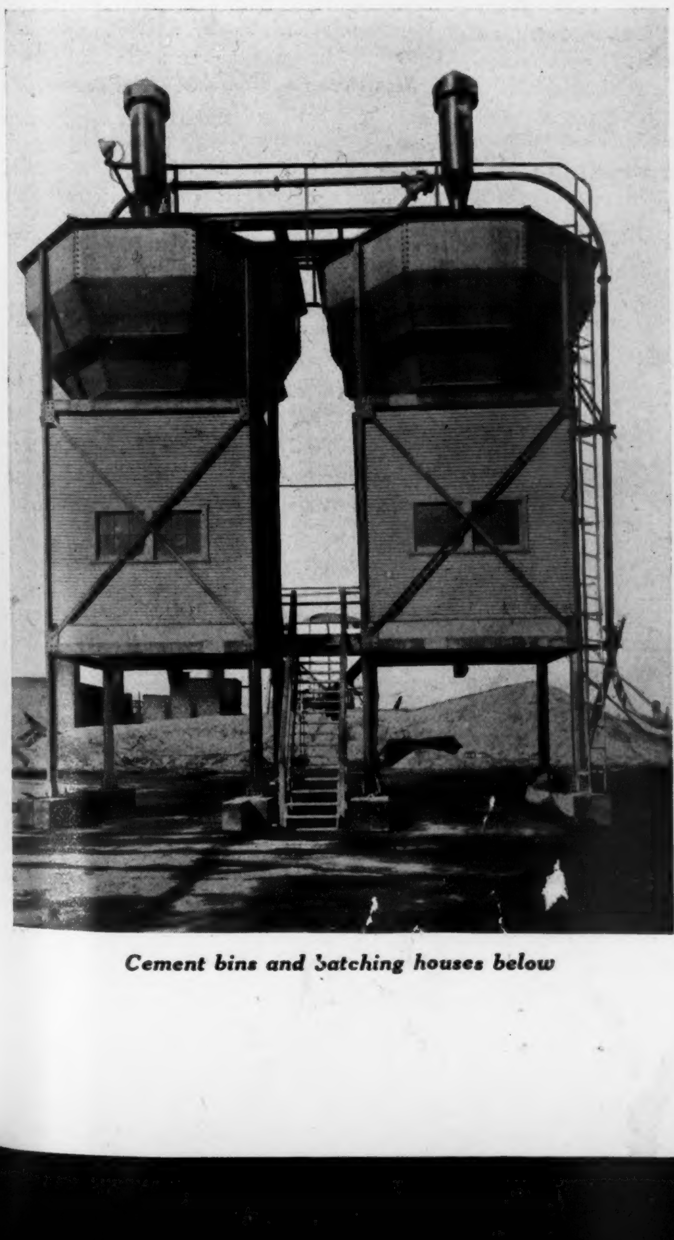


Plant of cement handling plant

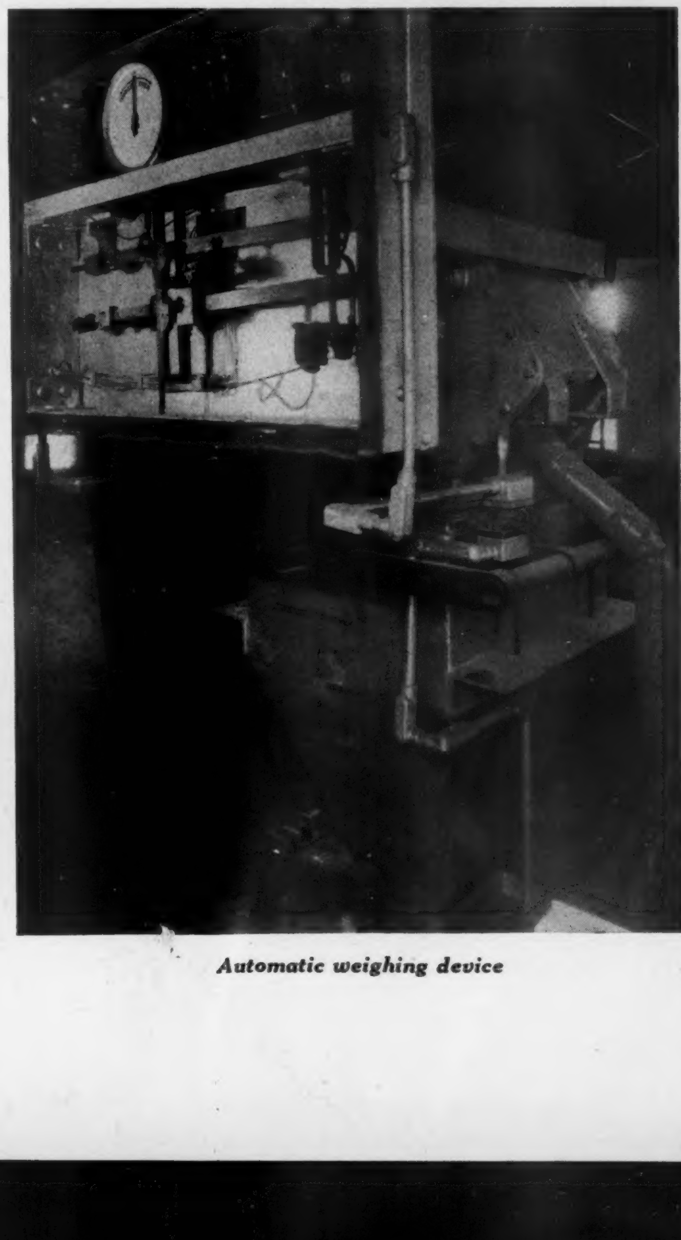
At the Moulding-Brownell yard the automatic batcher, which operates electrically, is mounted below a Johnson "Octo-bin" of 400-bbl. capacity. At the outlet of the steel bin is mounted a Fuller Co. rotary feeder. This consists of a drum with shallow recesses, turning in a housing, and is so designed that flooding is absolutely prevented. The shallow pockets in conjunction with a novel rapping device inside the drum insure an accurate and uniform feed. The feeder is driven by a 5-hp. Westinghouse induction motor, provided with a solenoid brake so that when the current is cut off the feeder stops immediately. Below the feeder is mounted a weighing hopper of 1100-lb. capacity, the outlet of which is provided with a Fuller rotary valve, opened and closed by means of a ¼-hp. motor.

The electrically operated feeder and the electrically operated discharge valve are tied in with the Buffalo scales so that the whole operation except the initial starting is automatic. The scales are provided with mercoid switches which automatically start and stop the feeder and also automatically open and close the discharge valve, the two operations being interlocked. The cycle of operation is then as follows:

The operator throws the switch, which starts the feeder; when the predetermined weight is in the weighing hopper the scale beam brakes the circuit and stops the feeder at once; the discharge gate opens and does not close until all the cement has run out;



Cement bins and batching houses below



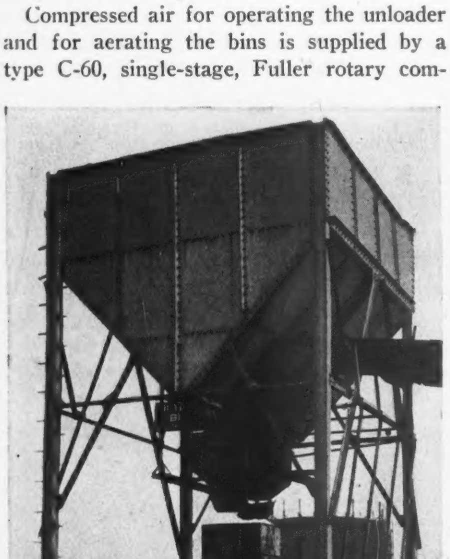
Automatic weighing device

the discharge valve then closes and the feeder starts on the next cycle.

To insure a quick discharge of the cement from the batcher, an electrically vibrated hammer has been mounted on the side of the hopper and starts operating when the discharge valve opens. The whole cycle requires 45 to 50 seconds. The weighing is said to be accurate within 1 lb. on a batch of 1000 lb.

Portland cement is received at the plant in box cars in bulk and is unloaded to the bins by means of a type "B," 40-hp. Fuller-Kinyon portable unloader. The unloader discharges through a 5-in. line which has a total length of 125 ft. and a rise of 40 ft. At the unloader a 30-ft. length of 5-in. rubber hose is included in the total pipe line length. The unloader has a capacity of 175 bbl. per hour.

Compressed air for operating the unloader and for aerating the bins is supplied by a type C-60, single-stage, Fuller rotary compressor.



One of the aggregate batching bins

This is direct-connected to a 40-hp. Westinghouse induction motor and delivers air to a 30-in. by 7-ft. vertical air receiver from which a service line extends to the unloader and batcher plant. The compressor has a rated capacity of 240 cu. ft. per min. and a guaranteed capacity of 208 cu. ft. per min. at 50-lb. pressure.

The concrete being placed at the present time is being used in caisson work. The specifications of the city of Chicago for caisson concrete for the Loop district call for 60% of 1½-in. stone and 40% of 1½-in. to 2-in. size. No. 2 torpedo sand is used. A cubic yard of concrete for this work consists of 22 cu. ft. of crushed stone aggregate (no gravel is used), 11 cu. ft. of sand and 11 bags (1034 lb.) of cement. This is a very rich mixture, as can be readily seen. The amount of water used is left to the contractor, as the equipment at the Eleanor street yard is dry-batching exclusively and this producer is only supplying a concrete mix, not ready-mixed concrete.

For other than caisson work one of the following specified concrete mixes, 1:1:2, 1:2:4, 1:2½:5, 1:3:6 and 1:1½:3, may be supplied, although any desired mix may be prepared if necessary.

American Concrete Pipe Association Meets

THE 25TH annual convention of the American Concrete Pipe Association was held in Chicago, February 1-2. The meeting was well attended. Representatives were present from all parts of the United States and Canada.

Following the opening address of President Bullen, in which he reviewed the progress of the industry in 1931, M. L. Loving, secretary, presented his report. In this report Mr. Loving reviewed the progress of the industry during the past 10 years, and cited various benefits to the industry which result from the work of the association.

Condition surveys of reinforced concrete pipe culverts by H. C. Delzell and C. M. Howard were discussed by C. F. Buente. The specification committees presented their reports and these were discussed at length.

The following officers were elected: C. H. Bullen, president; vice-presidents, C. E. Edwards, C. F. Buente and Colonel Longley; executive committee for 1935, T. A. Polansky, L. J. Loughlin and W. F. Paddock, and for 1933, G. D. Williamson.

Gypsum, Lime and Alabastine to Add Three Products in 1932

RESEARCH WORK, of which he is an ardent supporter, will enable Gypsum Lime and Alabastine Canada, Ltd., to put three new products on the market in 1932, stated J. F. Cameron, general sales manager of the company, while in Vancouver, B. C., recently. The new features have a bearing on acoustic improvements effected by the use of insulating plaster, he stated.

The company's British Columbia business, supplied by its New Westminster factory using materials produced in the province, is in a healthy condition, said Mr. Cameron.

To Study Mineral Resources of Pennsylvania

HARRY STODDARD, vice-president of the Albion Vein Slate Co., Bangor, Penn., has been appointed by Governor Pinchot to serve as a member of the Greater Pennsylvania Council, which assists the state government in the research and development of industry and resources of the state. The council has prepared an elaborate program of research covering the nonmetallic minerals of Pennsylvania.

Sand-Lime Brick Production and Shipments in January

THE FOLLOWING DATA are compiled from reports received direct from 20 producers of sand-lime brick, located in various parts of the United States and Canada. The statistics below may be regarded as representative of the industry in the United States and Canada.

From the figures below, comprising the reports of 20 sand-lime brick producers, or one more than reported for the December estimate, published in the January 30 issue, it is estimated that sand-lime brick production for the month of January showed a decrease as compared with the figures for the preceding month. Shipments by rail remain about the same, while shipments by truck also decreased somewhat. Stocks on hand are about the same as indicated for the previous month, and unfilled orders show a slight decrease.

Average Prices for January

Shipping point	Plant price	Delivered
Dayton, Ohio	$11.00	$12.00
Detroit, Mich.	....	14.50
Grand Rapids, Mich.	....	13.50
Jackson, Mich.	13.00	....
Madison, Wis.	12.50	14.00
Menominee, Mich.	10.75	13.50
Milwaukee, Wis.	8.00	10.00-12.00
Minneapolis, Minn.	6.50	8.50
Pontiac, Mich.	12.50	14.50
Saginaw, Mich.	10.50	....
Syracuse, N. Y.	18.00	20.00
Tampa, Fla.	8.00	....
Toronto, Ont., Can.	11.40	13.50

Statistics for December and January

	*December	†January
Production	3,117,580	2,188,150
Shipments (rail)	397,240	448,680
Shipments (truck)	3,630,165	2,560,693
Stocks on hand	8,676,979	9,066,624
Unfilled orders	8,745,000	8,700,000

*Nineteen plants reporting. Incomplete, two not reporting production, two not reporting stocks on hand, and ten not reporting unfilled orders.

†Twenty plants reporting. Incomplete, two not reporting production, and nine not reporting unfilled orders.

Announces a Tan Cement

OF UNUSUAL INTEREST is the announcement of a tan cement by the Pacific Portland Cement Co., San Francisco, Calif.

Color is playing a major part in developing sales for many products and this new development brings to the cement industry a certain sales stimulant.

This new cement, the manufacturer states, is a true portland cement guaranteed to pass the standard specifications of the American Society for Testing Materials. Its cost is said to make it practical for use in mass and monolithic concrete. It should also find a ready market in the cast stone industry.

In addition to being produced in standard quality, the new tan color is available in a plastic waterproof cement. It is called Golden Gate Tan cement.

Recent Prices Bid and Contracts Awarded

Pasadena, Calif. On recommendation of City Manager Charleville, the board of city directors has rejected all bids submitted on 3500 bbl. cement for the light department warehouse. Eight bids were received and all quoted cement at $2.68 per bbl. According to the manager's report the bids were too high.

Greenfield, Ind. The Hancock county commissioners have purchased 10,000 cu. yd. of gravel at a price of 20 to 50c. per yd. This is the lowest price that gravel has been purchased in a number of years.

Dayton, Ohio. City Purchasing Agent Maltby had bids for supplying 8000 tons of crushed stone to be used on Dayton streets during the current year, totaling $10,420, recently.

The low bid on 2500 tons of No. 6 state specified material was submitted by the American Stone Co. of Lima, Ohio, at a figure of $1.15 per ton. The Laura Gravel Co. of Phillipsburg was low bidder on 2500 tons of ¾-in. crushed stone with a figure of $1.53 per ton, while the Keystone Gravel Co. and the Mad River Gravel Co., Dayton, bid $1.24 per ton each in dividing a consignment of 3000 tons of the same material.

Bluffton, Ind. The Adams county, Ind., commissioners awarded contracts at their meeting recently for stone for highway repairs. Three companies that filed bids offered stone at 90c. per ton at the quarries. This is 10c. lower than quotations by the stone companies for stone to the county last year.

Mt. Vernon, Ind. The Koch Sand and Gravel Co., Evansville, was awarded the bulk of the Posey county gravel contracts by county commissioners recently.

A. E. Fretageot's only bid was to supply gravel at New Harmony and he was the successful bidder. His bid was $1.00 per cu. yd.

The bids of the Koch company were as follows per cu. yd.: Mt. Vernon, $1.00; Wadesville, $2.18; Cynthiana, $1.95; Wendel Station, $1.94; Poseyville, $1.85; Stewartsville, $1.89; Griffin, $1.89; St. Phillips, $1.73; and Ford Station, $1.75. All bids were for delivery of the gravel on the banks of the river or f.o.b. railway cars at the points of delivery.

The gravel is to be used by the county highway maintenance department.

Yakima, Wash. A contract for 1250 bbl. of cement at $2.70 per bbl. to be used in building the power plant at the Wapato project was recently awarded.

Baltimore, Md. Each of 14 bidders quoted $1.86 per bbl. to furnish the Baltimore Department of Public Works with 60,000 bbl. of cement, at a meeting of the board of awards recently.

Syracuse, N. Y. Oliver S. Cane, county purchasing agent, Syracuse, N. Y., had not decided on award of the contract for 76,000 bbl. of cement, but his action in rejecting all bids opened 10 days previously had proved successful in forcing the price down.

The second advertising of bids forced all but one of the bidders out. Mr. Cane originally had sent notices to 35 firms, five of which entered bids the first time.

The new bid was $1.92 a bbl. f.o.b. county trucks at Jamesville, 10c. a bbl. discount for cash in 15 days, in cloth, or $1.87 a bbl. plus $9 prepaid freight a car, delivered to the county siding at Jamesville.

Salem, Ohio. The Salem Builders Supply Co. was awarded contract to furnish cement, sand and gravel here recently. It bid $1.52 per bbl. on cement, and $1.80 a ton on sand and gravel.

Greenfield, Ind. The board of county commissioners has contracted to purchase over 16,000 cu. yd. of gravel in various places over the county, for use on the county road system, at prices ranging from 37½c. to 55c. per cu. yd., for dredged gravel and 20 to 25c. for bank gravel.

To Protect Road Investment Must Build More Roads

ASIDE from the provision of jobs, road building should continue at its present pace for the important reason that the existing investment in highways and the methods of transportation must be protected.

So declared Frederic E. Everett, president of the American Association of State Highway Officials, in discussing the state and federal programs for 1932.

"Mass production has necessarily been adopted in road building," said Mr. Everett, "wherein first-stage improvement has been given vast mileages. As rapidly as possible such temporary improvements have been elevated to high type construction and in the meantime the roads have been giving a fair degree of service to the forever increasing traffic.

"Any curtailment of construction would have a devastating effect on the mileage of roads now ready for a better type improvement. When we see cars rolling smoothly over even rough road surfaces we are likely to minimize their destructive effects. But a road carrying only 300 cars a day bears a pounding burden of from 600 to 1000 tons. Gravel is whirled to the four winds. Low type surfaces crumble under heavy traffic. A delay of a single year would cost government and motorists amazing sums in high road and car upkeep costs.

"To illustrate the problem, glance at what needs to be done on the federal aid road system. Of the 193,000 miles of highways on the system, 109,000 have been benefited by federal expenditures. Of these 109,000 miles a very large part is still in need of an adequate type of surface to meet the traffic requirements, and in terms of car operating costs and surface upkeep costs, expenditures for further improvement are justified. A federal reduction means a breakdown all along the line.

"A nation equipped with 26,000,000 motor cars, a nation that travels 150,000,000,000 miles a year over rural roads, and a nation possessed of a rightful desire for motor travel, should not falter in road construction," concluded Mr. Everett.

Indiana County to Use Pit Gravel in Road Improvement

RECENT REPORTS in the *Vincennes* (Ind.) *Sun* state that road viewers have insisted on the use of pit gravel for road improvement. The viewers claimed traffic on the roads to be surfaced was so light that pit gravel would be satisfactory.

It reported pit gravel could be purchased for 25c. per cu. yd. while prepared gravel would cost 70c. per yd.

Universal Gypsum Opens New Sales Office

THE UNIVERSAL GYPSUM AND LIME CO., Chicago, Ill., announces the opening, March 1, of a new sales office in direct connection with its lime plant at York, Penn. This plant, it will be remembered, was operated by the Palmer Lime and Cement Co. until 1926, at which time it was consolidated with the Universal company's interests. Harry G. Hoehler has been appointed division sales manager in charge of the newly opened office and will supervise the distribution of the company's extensive line of lime products in the eastern territories.

Buys Crushed Stone with Scrip

SINCE the "credit slip" plan of purchaschasing rock was put into effect by Garden City, Mo., less than two months ago, more than 200 tons of rock have been purchased at the prescribed price of 70c per ton. The city plans to continue buying rock until 400 tons have been received. Bids for a rock crusher to crush the rock on hand will be received at the present time.

Each person bringing in a load of rock was given a slip indicating the amount received, and on presenting this at a local store he received credit on account. The merchant in turn was given a city warrant. Through the operation of this plan many old debts have been discharged.—*Garden City* (Mo.) *Views.*

Beg Your Pardon

WE REGRET that in the February 13 issue, page 102, in announcement of changes in the Allis-Chalmers Manufacturing Co., the pictures of L. W. Grothaus and C. E. Searle were inadvertently transposed. In the text Mr. Searle's name should have been C. E. Searle.

Current Prices of Ready-Mix Concrete

AMARILLO, TEX.—Prices per cu. yd.*

Lime Mortar

Mix	
1-4	6.50
1-4½	6.25
1-5	6.00

Terrazzo

Mix	
1-3 -0	9.75
1-3½-0	9.25
1-4 -0	8.75
1-4½-0	8.50
1-5 -0	8.25

Topping

Mix	
1-1 -0	13.75
1-1½-0	12.75
1-2 -0	11.75
1-2½-0	11.25
1-3 -0	10.75
1-3½-0	10.25

Base—Strength

4000 lb. per sq. in.	9.75
3500 lb. per sq. in.	9.25
3000 lb. per sq. in.	9.00
2500 lb. per sq. in.	8.75
2000 lb. per sq. in.	8.50
1500 lb. per sq. in.	8.25

Base

Mix		Mix	
1-2 -3½	9.25	1-3 -5	8.00
1-2¼-4	9.00	1-4 -6	7.25
1-3½-4½	8.00		

*For orders of 50 cu. yd. or more, prices are 75c less per cu. yd. than quoted. Free delivery within city limits for 2 cu. yd. or more per load; $1.00 per load extra for less than 2 cu. yd. loads, except to finish a job. Additional charge of 10c per mile per cu. yd. for deliveries outside of city limits.

BELLINGHAM, WASH.—Prices per cu. yd.¶

Mix	Retail, f.o.b. bunkers	In carloads	Mix	Retail, f.o.b. bunkers	In carloads
1-3-4	6.85	6.10	1-2-3	7.85	6.91
1-3-5	6.51	5.75	1-2-4	7.27	6.50

¶Additional charges for delivery to various zones. First zone, added charge of 75c per cu. yd.; second zone, added charge of $1.05; third zone, added charge of $1.40; fourth zone, added charge of $1.75.

BOSTON AND CAMBRIDGE, MASS.—Price per cu. yd. for orders of 30 cu. yd. and over.‡

Mix		Mix	
1-2 -4	7.25	1-1½-3	7.80
1-3 -6	6.75	1-1 -2	8.55
1-2½-5	7.00	1-2	10.25
1-2 -3	7.70		

‡Discount of 50c per cu. yd. allowed on deliveries made between the 1st and 15th of the month if bill is paid on or before the 25th and on deliveries made between 15th and 30th if paid on or before the 10th of following month.

CHAMPAIGN, ILL.†—Prices per ton (weight, 4000 lb. per cu. yd.)

Mix		Mix	
1-2-3	5.25	1-2-4	4.75
1-3-5	4.50		

† 5% trade discount to contractors. Prices to both contractor and consumer subject to cash discount of 5% for payment by 10th of month following del. For quick strength concrete, 1-2-3 mix, extra charge of $1.50 per ton; 1-2-4 mix, $1 per ton extra. Added charge of 25c per ton for the use of chloride, lime or Celite in any wet mix. For heating concrete, 12½c extra per ton. For topping, any mix, $1.35 for each sack of cement used.

COLUMBUS, OHIO—Delivered prices per cu. yd.

Mix	Zones§ 1	2	3	4	5	6	7	8	9	10
1-1½-3	6.05	6.20	6.35	6.50	6.65	6.80	6.95	7.10	7.25	7.40
1-2 -3	5.80	5.95	6.10	6.25	6.40	6.55	6.70	6.85	7.00	7.15
1-2 -3½	5.60	5.75	5.90	6.05	6.20	6.35	6.50	6.65	6.80	6.95
1-2 -4	5.40	5.55	5.70	5.85	6.00	6.15	6.30	6.45	6.60	6.75
1-2½-4	5.25	5.40	5.55	5.70	5.85	6.00	6.15	6.30	6.45	6.60
1-3 -4	5.15	5.30	5.45	5.60	5.75	5.90	6.05	6.20	6.35	6.50
1-2½-5	5.00	5.15	5.30	5.45	5.60	5.75	5.90	6.05	6.20	6.35
1-3 -5	4.90	5.05	5.20	5.35	5.50	5.65	5.80	5.95	6.10	6.25
1-3 -6	4.75	4.90	5.05	5.20	5.35	5.50	5.65	5.80	5.95	6.10
1-4 -8	4.50	4.65	4.80	4.95	5.10	5.25	5.40	5.55	5.70	5.85
1-2	7.45	7.60	7.75	7.90	8.05	8.20	8.35	8.50	8.65	8.80
1-3	6.60	6.75	6.90	7.05	7.20	7.35	7.50	7.65	7.80	7.95

§All zones radiating from center of city. Zone 1 is one mile in radius, zone 2 is two miles in radius, zone 3 is three miles in radius, etc. Discount of 25c per cu. yd. allowed for payment 10th of month following delivery date. For orders over 50 cu. yd. a deduction of 25c per cu. yd. is allowed. Orders of less than 2 cu. yd. carry same haul charge as 2 cu. yd. load. Orders for 2 cu. yd. or over delivered in full loads at 2 yd. or more.

DALLAS, TEX.†

Strength	Slump ½ in. to 1 in.	3 in. to 4 in.	6 in. to 7 in.	Strength	Slump ½ in. to 1 in.	3 in. to 4 in.	6 in. to 7 in.
1500	5.25	5.45	5.85	2500	5.80	6.00	6.40
2000	5.55	5.75	6.05	3000	6.15	6.55	6.75

Fixed Mixes (any slump)

1-2½-5	6.45	1-2-4	6.75	1-1½-3	7.45

†Prices subject to 2% 15 days and are based on quantities of 50 to 999 cu. yd. and on delivery in 2½-cu. yd. loads within Zone 1, which extends about 1½ miles from either of two plants. Zone charges are approximately 10c per cu. yd. per mile beyond the Zone 1 limit. On quantities under 50 cu. yd. add 20c and on quantities over 1000 cu. yd. deduct 30c.

CLEVELAND, OHIO (a)—Prices per cu. yd. to contractors for orders of 2 cu. yd. or more.

Public Square basing point
Aggregate: Limestone

Mix	1st mile	2nd mile	3d mile (Maximum)
1-1 -2	7.50	7.75	8.00
1-2 -3	6.30	6.55	6.80
1-2 -4	6.00	6.25	6.50
1-2½-3½	6.00	6.25	6.50
1-2½-4	5.80	6.05	6.30
1-3 -4	5.70	5.95	6.20
1-2½-5	5.60	5.85	6.10
1-3 -5	5.50	5.75	6.00
1-3 -6	5.40	5.65	5.90
1-4 -8	5.25	5.50	5.75
1-2 Finish	7.50	7.75	8.00
1-2½ Finish	7.00	7.25	7.50
1-3 Finish	6.50	6.75	7.00

Basing point: Windfall Road and Broadway, Bedford, Ohio
Aggregate: Bedford gravel

Mix	Miles 1st	2nd	3rd	4th	5th	6th	7th*
1-1 -2	6.50	6.75	7.00	7.25	7.50	7.75	8.00
1-2 -3	5.30	5.55	5.80	6.05	6.30	6.55	6.80
1-2 -4	5.00	5.25	5.50	5.75	6.00	6.25	6.50
1-2½-3½	5.00	5.25	5.50	5.75	6.00	6.25	6.50
1-2½-4	4.80	5.05	5.30	5.55	5.80	6.05	6.30
1-3 -4	4.70	4.95	5.20	5.45	5.70	5.95	6.20
1-2½-5	4.60	4.85	5.10	5.35	5.60	5.85	6.10
1-3 -5	4.50	4.75	5.00	5.25	5.50	5.75	6.00
1-3 -6	4.40	4.65	4.90	5.15	5.40	5.65	5.90
1-4 -8	4.25	4.50	4.75	5.00	5.25	5.50	5.75
1-2 Finish	7.00	7.25	7.50	7.75	8.00*	......	......
1-2½ Finish	6.50	6.75	7.00	7.25	7.50*	......	......
1-3 Finish	6.00	6.25	6.50	6.75	7.00*	......	......

*Maximum.

(a) Industrials or consumers 50c more than contractors. Extra charge for concrete delivered nights, Sundays or holidays, $1.00 per cu. yd. over daytime schedule. For high-early-strength or waterproofing cements additional charge of $2.00 per cu. yd. For waterproof concrete using Anti-Hydro with manufacturer's guarantee, additional charge of $2.00 per cu. yd. For orders less than 2 cu. yd. add $1.00 per yd. to above prices. Prices quoted are based upon normal discharge of load within 20 minutes after arrival of truck. A demurrage charge of $1.00 for each 15 minutes thereafter.

DES MOINES, IOWA—Prices per cu. yd. (b)

(Made with ¾-in. gravel for structural work)

Mix	Slump	Plant price	Zone A	B	C	D
1-2½-5	2-in.	6.00	6.50	6.75	7.00	7.25
1-2½-5	6 in.	6.25	6.75	7.00	7.25	7.50
1-2 -4	2 in.	6.50	7.00	7.25	7.50	7.75
1-2 -4	6 in.	6.75	7.25	7.50	7.75	8.00
1-2 -3½	2 in.	7.00	7.50	7.75	8.00	8.25
1-2 -3½	6 in.	7.25	7.75	8.00	8.25	8.50
1-2½-3	2 in.	7.50	8.00	8.25	8.50	8.75
1-2½-3	6 in.	7.75	8.25	8.50	8.75	9.00

(Made with pea gravel for cellar and sidewalks)

Mix	Slump	Plant price	Zone A	B	C	D
1-2½-5	2 in.	5.75	6.25	6.50	6.75	7.00
1-2½-5	6 in.	6.00	6.50	6.75	7.00	7.25
1-2 -4	2 in.	6.25	6.75	7.00	7.25	7.50
1-2 -4	6 in.	6.50	7.00	7.25	7.50	7.75
1-2 -3½	2 in.	6.75	7.25	7.50	7.75	8.00
1-2 -3½	6 in.	7.00	7.50	7.75	8.00	8.25
1-2½-3	2 in.	7.25	7.75	8.00	8.25	8.50
1-2½-3	6 in.	7.50	8.00	8.25	8.50	8.75

(b) Discount of 50c per cu. yd. allowed on deliveries made between the 1st and 15th of the month if bill is paid before the 25th and on deliveries made between 16th and 30th if paid before the 10th of following month. Quick setting $2.00 per cu. yd. extra; waterproofing, $2.00 per cu. yd. extra. Each zone approximately one mile.

FAIRMONT, W. VA.—Prices per cu. yd. (c)

Mix	Quantity	Delivered	Called for
1-2-4	Less than 1 cu. yd.	11.00	10.00
1-2-4	From 1 to 4 cu. yd.	10.00	9.00
1-2-4	From 5 to 10 cu. yd.	9.50	8.50
1-2-4	From 11 to 49 cu. yd.	9.00	8.00
1-2-4	From 50 cu. yd. and up	8.50	7.50

(c) For 1-2-3 mix add 50c per cu. yd. to prices quoted; for 1-3-5 mix deduct 50c per cu. yd. from prices quoted.

INDIANAPOLIS, IND.—Prices per cu. yd. in small quantities, for delivery within 3-mile haul.

Mix	
1 bbl. cement/cu. yd. concrete	5.50
1¼ bbl. cement/cu. yd. concrete	6.00
1½ bbl. cement/cu. yd. concrete	6.50

LOS ANGELES, CALIF.¶—Prices per cu. yd.

Mix	1-5 yd.	5-25 yd.	25 or more	Mix	1-5 yd.	5-25 yd.	25 or more
3-50-50	8.25	7.25	6.25	1-2¾-3½	10.00	9.00	8.00
4-50-50	8.85	7.85	6.85	1-2 -4	9.85	8.85	7.85
1-3 -6	8.95	7.95	6.95	1-2½-3½	10.10	9.10	8.10
1-3 -5	8.95	7.95	6.95	1-2½-3¼	10.05	9.05	8.05
1-2½-5	9.50	8.50	7.50	1-2 -3	10.60	9.60	8.60
1-3 -4	9.75	8.75	7.75	1-2 -3½	10.20	9.20	8.20

¶Above prices for deliveries in Zone 1 (1-5 miles). Added charge of 75c per cu. yd. for deliveries in Zone 2 (5 to 10 miles). Added charge of $1.50 for Zone 3 (10 to 15 miles). Discount of 50c per cu. yd. if payment is made within 10 days from delivery.

MEMPHIS, TENN.—Prices per cu. yd. delivered in city.†

Strength	Portland	"Incor"	Strength	Portland	"Incor"
1800 lb.	6.50	7.30	3000 lb.	8.00	9.25
2000 lb.	7.00	8.00	3500 lb.	8.60	10.00
2500 lb.	7.50	8.50	4000 lb.	9.80	11.75

†Above prices based on gravel for aggregate. If stone is wanted for aggregate, additional charge of $1.00 per cu. yd. is made to above prices. 5% cash discount for payment 10th of month following date of invoice.

MILWAUKEE, WIS.—Prices per cu. yd. (e)

28-day breaking strength:	Per sq. in.	Slump 2 to 4 in.	4 to 6 in.	6 to 8 in.
Garage footings and walls	2000 lb.	4.50	4.75	5.00
Footings, floors, walls	3000 lb.	5.50	5.75	6.00
City paving	3300 lb.	4.75	.....	.....
Sidewalks, curbs	4000 lb.	5.75	6.00	6.25
24-hour high early strength	5000 lb.	7.00	7.50	8.00

Sold on old mixture method, 2- to 4-in. slump; 4- to 6-in. slump; 6- to 8-in. slump.

	Mix	
Walls—Garage footing	1-3-5	4.50
City paving	1-2-4	4.75
Garage floors, walls	1-3-3	5.50
Sidewalk	1-2-3	5.75
Special strength (machine bases)	1-1½-2½	7.00
Facing	1-3	8.00
Facing	1-2	10.00

(e) Discount of 25c per cu. yd. if paid by 10th of following month.

MONTGOMERY, ALA.—Prices per cu. yd. delivered in city limits. (g)

Mix		Mix	
1-2 -4	6.60	1-3-6	5.95
1-2½-5	6.20	1-2 mortar topping	11.50

(g) Discount of 25c per cu. yd. for payment in 30 days. Special quotations for quantity orders.

MORGANTOWN, W. VA.—Prices for jobs of 1 to 10 cu. yd., delivered (f)

Mix		Mix	
1-2-3	9.25	1-2½-4	8.65
1-2-4	8.75	1-2½-5	8.25

(f) Prices subject to cash discount of 25c per cu. yd. for payment 15 days from date of invoice.

NEW ORLEANS, LA. (h)—Plant prices per cu. yd. for 30 yd. or less.

Mix	Cement Portland	"Incor"	Mix	Cement Portland	"Incor"
1-4 -8	5.15	6.10	1-2-2	7.70	10.25
1-3 -6	5.75	7.00	2-3-6	8.05	10.55
1-3 -5	5.95	7.35	2-3-3	8.85	12.00
1-2½-5	6.25	7.80	1-1½ topping	10.95	15.80
1-2½-4	6.40	8.15	1-2 topping	9.30	13.25
1-2 -4	6.75	8.60	1-3 topping	7.85	10.85
1-2 -3	7.20	9.40			

Plant prices per cu. yd., 30 cu. yd. or over:

Mix	Cement Portland	"Incor"	Mix	Cement Portland	"Incor"
1-4 -8	4.65	5.45	1-2-2	6.95	9.15
1-3 -6	5.15	6.25	2-3-6	7.25	9.45
1-3 -5	5.35	6.55	2-3-3	8.00	10.70
1-2½-5	5.65	7.00	1-½ topping	9.85	14.10
1-2½-4	5.80	7.25	1-2 topping	8.40	11.80
1-2 -4	6.05	7.70	1-3 topping	7.05	9.60
1-2 -3	6.50	8.40			

(h) All prices subject to 5% 15 days, 30 days net. Haulage based on various zones.

NEWARK AND HARRISON, N. J.§

1-2 -4	7.50	1-3 -6	6.75
1-3 -5	7.00	1-2½-5	6.85

§Discount of 2% if paid by 10th of month following delivery.

NEW YORK CITY, N. Y.‡—Prices per cu. yd.

Manhattan and Bronx Mix		Queens Mix	
1-1½-3	10.00	1-1½-3	8.50
1-2 -4	9.25	1-2 -4	8.00
1-2½-5	8.75	1-2½-5	7.75
1-3 -6	8.25	1-3- 6	7.50

Westchester County (within radius of 7 miles)

1-1½-3	9.25	1-2½-5	8.00
1-2 -4	8.50	1-3 -6	7.50

Brooklyn

Mix	Under 50 cu. yd.	Over 50 cu. yd.	Mix	Under 50 cu. yd.	Over 50 cu. yd.
1-1½-3	9.50	8.50	1-2½-5	9.00	7.75
1-2 -4	9.25	8.00	1-3 -6	8.75	7.50

‡Special designed mixes on the strength basis priced according to the strength desired.

OMAHA, NEB.*—Prices per cu. yd. for quantities from 1 to 300 yd., delivered anywhere within the city.

	28-day strength			28-day strength	
No. 1.	3500 lb. sq. in.	7.35	No. 3.	2500 lb. sq. in.	6.95
No. 2.	3000 lb. sq. in.	7.15	No. 4.	2000 lb. sq. in.	6.75

Transit-Mix Concrete

	28-day strength			28-day strength	
No. 1.	3600 lb. sq. in.	7.50	No. 3.	2600 lb. sq. in.	7.10
No. 2.	3100 lb. sq. in.	7.30	No. 4.	2100 lb. sq. in.	6.90

*Sand-gravel mix used as aggregate. No. 1, 6 sacks cement per cu. yd. concrete; No. 2, 5½ sacks cement; No. 3, 5 sacks cement; No. 4, 4½ sacks cement. For high-early-strength concrete using "Quikard" or other super-cement, add $2.50 per cu. yd.

PITTSBURGH, PENN.—Range of prices, according to zone, for ready-mixed concrete. Prices per cu. yd. delivered, up to 50 cu. yd. (j)

Mix	Strength		Mix	Strength	
1-1½-2½	4000 lb.	8.10	1-2½-4½	2500 lb.+	7.25
1-2 -3	3500 lb.+	7.75	1-2½-5	2500 lb.	7.10
Class A	3500 lb.	7.60	1-3 -5	2000 lb.	7.00
1-2½-3½	3000 lb.+	7.50	1-3 -6	1500 lb.	6.90
1-2 -4 Class B	3000 lb.	7.40			

Prices per cu. yd. delivered, over 50 cu. yd. (j)

Mix	Strength		Mix	Strength	
1-1½-2½	4000 lb.	7.10	1-2½-4½	2500 lb.+	6.25
1-2 -3	3500 lb.+	6.75	1-2½-5	2500 lb.	6.10
Class A	3500 lb.	6.60	1-3 -5	2000 lb.	6.00
1-2½-3½	3000 lb.+	6.50	1-3 -6	1500 lb.	5.90
1-2 -4 Class B	3000 lb.	6.40			

(j) Class A concrete is a special concrete prepared for the city of Pittsburgh. Plus indicates the strength shown is the minimum strength. Dealer's commission of 50c per cu. yd. allowed in all zones with exception of Yellow Zone. No commission allowed over 200 cu. yd. Prices subject to cash discount of 25c per cu. yd. for payment 15 days from date of invoice.

PUEBLO, COLO.—Prices per cu. yd.‖

Ready-Mixed Concrete

	Zone 1	Zone 2	Zone 3	Strength, 28-day test
Grade A	7.40	7.60	7.80	3000-lb.
Grade B	7.10	7.30	7.50	2700-lb.
Grade C	6.75	6.95	7.15	2400-lb.
Grade D	6.60	6.80	7.00	2100-lb.
Grade G	6.10	6.30	6.50	1500 lb.

Cement Mortar

Mix	Zone 1	Zone 2	Zone 3	Mix	Zone 1	Zone 2	Zone 3
1-2	10.00	10.20	10.40	1-3	8.50	8.70	8.90

‖Deduct 50c per cu. yd. for orders of 10 yd. or more. For delivery outside of city, add 20c per mile beyond Zone 3.

ROCHESTER, N. Y.—Prices per cu. yd.

Mix	Plant price	Prices for delivery to various zones Zone 1	2	3	4	5	6	7
1-2 -3	7.00	7.75	7.90	8.05	8.20	8.35	8.50	8.65
1-2½-3½	6.55	7.30	7.45	7.60	7.75	7.90	8.05	8.20
1-3 -4½	6.20	6.95	7.10	7.25	7.40	7.55	7.70	7.85
1-4 -5	6.00	6.75	6.90	7.05	7.20	7.35	7.50	7.65
1-5 -6	5.65	6.40	6.55	6.70	6.85	7.00	7.15	7.30

SAN ANTONIO, TEX.—Prices per cu. yd. on city deliveries.‡

Mix		Mix	
1-3-5	6.50	1-2-4	7.00

‡Deduction of 50c per cu. yd. on large orders for delivery one mile of plant.

SAN JOSE, CALIF.—Prices per cu. yd. delivered within one mile of plant. (k)

Mix	Up to 5 cu.yd.	Over 5 cu.yd.	Mix	Up to 5 cu.yd.	Over 5 cu.yd.
1-6	9.00	8.50	1- 9	8.00	7.50
1-7	8.50	8.00	1-12	7.00	6.50

(k) For deliveries outside of this area add 30c per cu. yd. per mile. Cash discount of 50c per cu. yd. if paid in full by 10th day of following month.

SANTA CRUZ, CALIF.—Price per cu. yd. delivered within two-mile radius of plant. (l)

Mix	Over 5 cu.yd.	Less than 5 cu.yd.	Mix	Over 5 cu.yd.	Less than 5 cu.yd.
1-6	9.00	9.50	1-8	8.10	8.60
1-7	8.50	9.00	1-9	7.90	8.40

(l) For deliveries outside of this area add 30c per cu. yd. per mile. Cash discount of 50c per cu. yd. if paid in full by 10th day of following month.

SPRINGFIELD, ILL.—Prices per cu. yd.

Mix		Mix	
1-3 -6	9.00	1-2 -3½	10.00
1-3 -5	9.20	1-2 -3	10.20
1-2½-4	9.45	1-1½-3	10.55
1-2 -4	9.75	1-1 -2	11.25

WATSONVILLE, CALIF.—Prices per cu. yd.‖

Mix		Mix	
1-6	9.90	1- 9	8.50
1-7	9.30	1-12	7.75
1-8	9.00		

‖Prices are for delivery anywhere within city limits, and are subject to cash disc. of 50c cu. yd. for payment on or before 10th day of following month.

WILKES-BARRE, PENN.—Prices per cu. yd. delivered within one mile of plant, subject to discount of 25c per cu. yd. for payment within 10 days from date of delivery. Extra charge of 15c per cu. yd. for each additional mile.

Mix	Gravel	Stone	Mix	Gravel	Stone
1-2 -3	7.60	7.90	1-3-5	6.75	7.05
1-2 -4	7.30	7.60	1-3-6	6.75	7.05
1-2½-5	7.00	7.30			

Research on Cyclone Dust Collectors

By Louis C. Whiton, Jr.*
New York, N. Y.

UNTIL RECENT YEARS the design and construction of cyclone dust collectors has been largely empirical and comparatively little has been published concerning the effect of the numerous variables that influence the operation of cyclones.

It was with the idea of clarifying these problems and of putting the cyclone on a thoroughly scientific basis that the Prat-Daniel Corp., a number of years ago, undertook an extensive investigation of cyclone characteristics. Out of the research came a vast quantity of information from which several general conclusions can be drawn. It is perhaps unfortunate that it is impossible to give here a resumé of the entire research. However, a number of conclusions of significance to cyclone users can be set forth, which are offered in the hope that they will give them a clearer understanding of what goes on in connection with their apparatus.

Part of the investigation was carried out through the courtesy of the Brooklyn Polytechnic Institute, which placed extensive facilities at our disposal for use in conjunction with apparatus which we supplied. Part was done at the company's New Rochelle plant; and part by the research division of the associated French Co. Correlation of these several researches makes it possible to present conclusions on the following points: effect on collection of (1) collector diameter; (2) collection velocity; (3) collection temperature; (4) mesh of dust; (5) grain loading; (6) arrangement of outlet pipe at the bottom of the cyclone; (7) rate of emptying the cyclone. There is also some rather interesting data available on the distribution of pressure within an operating cyclone.

Synopsis

THE AUTHOR describes research to determine the efficiencies of 1-, 2- and 3-ft. diameter cyclone dust collectors, of different heights and shapes, with reference to collection velocity, temperature, mesh of dust particles, grain loading (density of gas and dust mixture), arrangement of outlet pipe and rate of emptying cyclone.

After experimenting with various industrial dusts, including portland cement, an electrically precipitated boiler stack dust from pulverized coal burners was used. Screen tests were made to determine the fineness of this dust. On the basis of these tests conclusions were drawn regarding dusts of finer sizes.

Some interesting conclusions are arrived at regarding the efficiencies and capacities of mechanical dust collectors, of value to all interested in the dust collection problem—which certainly includes most producers and manufacturers of rock products.—The Editor.

Test Apparatus

The description of the final test apparatus is simplified as much as possible, since it was somewhat more complicated than that indicated in Fig. 1. This complication was due to the arrangement of cyclones so that their relative dimensions could be changed at will. Each type of cyclone from the standpoint of diameter, was capable of being increased or decreased in height so as to obtain six different shaped cyclones. Each of the cyclones was also equipped with several outlet collars which could be placed at any desired position below the top of the cyclone, and each cyclone had several bottom cones. This permitted 108 proportions of cyclone design for each diameter cyclone. The research concerning these many combinations is too lengthy to give in this article and consequently the results mentioned were obtained with a design finally adopted as the most efficient for commercial purposes.

As will be seen in Fig. 1, the apparatus consisted of the following: A gas-heated brick furnace constructed for producing the necessary heated gas when testing cyclones at temperatures higher than atmospheric. Between the furnace and the fan was an inlet hopper for the introduction of the dust. A duct then passed to the inlet of the 1 ft., 2 ft., and 3 ft. diameter cyclones. Each cyclone could be blanked off by blank flanges, which were arranged so that there could be no possible collection of dust within the duct itself, thus falsifying the efficiency readings. The outlets of the cyclones were connected to a 15-ft. straight run of pipe, 17¾ in. in diameter, at the beginning of which vanes were placed so as to avoid a whirling of the gas through the pipe. Pitot-tube readings were taken at five places in this circular pipe. The end of the pipe was connected with a Canton-flannel bag 21 ft. long and 74 in. in circumference.

The determination of efficiency was made by introducing a known weight of dust into the system and measuring the quantity of dust caught which was checked against the quantity of dust in the cloth bag which escaped the cyclone collector.

The materials which were tested covered a large variety, ranging from fly ash, which had been obtained from electrical precipitators, at one of the large central power stations in New York City, Fullers earth of various meshes, such as is used for the bleaching of lubricating oils in the petroleum industry, cement kiln dust, gray cement, and a variety of industrial products. For pur-

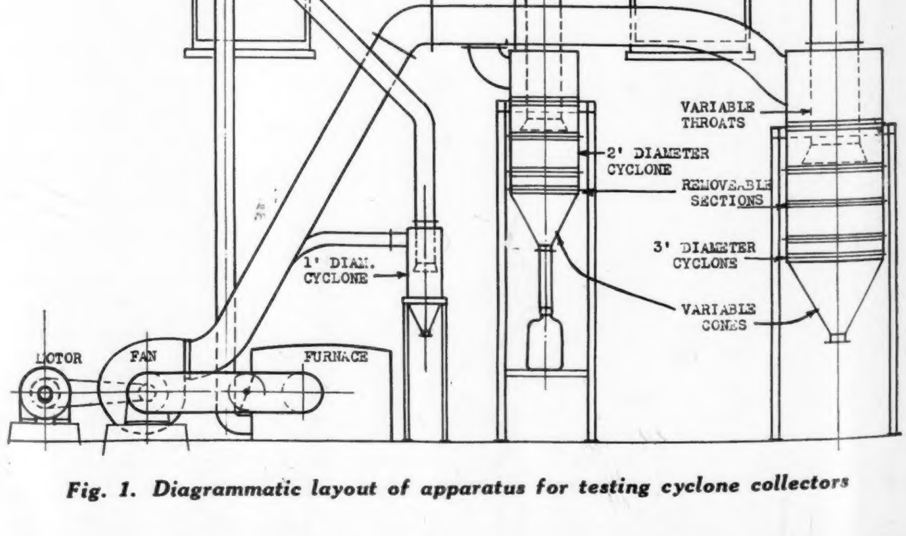


Fig. 1. Diagrammatic layout of apparatus for testing cyclone collectors

*President, Prat-Daniel Corp.; written for presentation at the technical meeting of the Metropolitan section, New York, N. Y., February 18, 1932, of the American Society of Mechanical Engineers. All papers are subject to revision.

Note: Statements and opinions advanced in papers are to be understood as individual expressions of their authors, and not those of the Society.

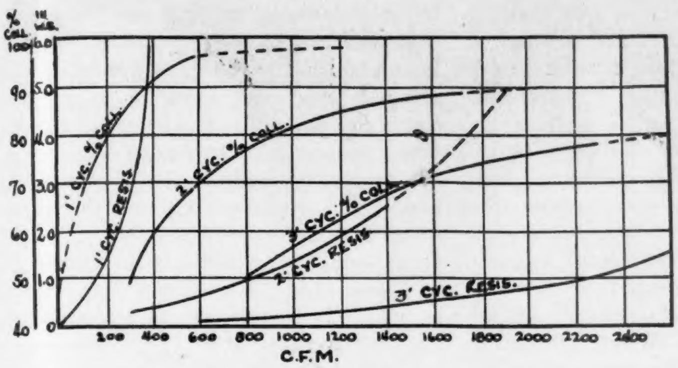


Fig. 2. Efficiency, resistance and capacity of 1, 2 and 3-ft. diam. cyclones at 80 deg. F.

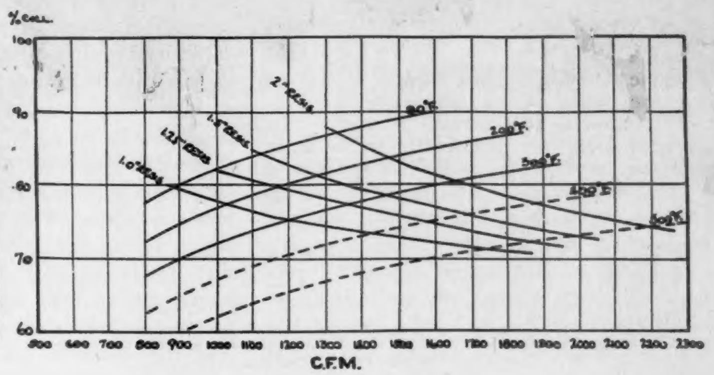


Fig. 3. Efficiency, resistance and capacity of 2-ft. diam. cyclones at varying temperatures

poses of comparison the fly ash from the pulverized-fuel installation was taken as the standard material in the tests. Due to the fact that it was collected by electrical methods an average cross section as to fineness of dust produced from pulverized fuel burning was to be expected with this material.

Tests as to the fineness of the dust were made in a Ro-tap testing apparatus and in all cases the dust was dried beforehand so as to have a uniform moisture content, as it was observed that the dust was fairly hygroscopic and varied in physical characteristics somewhat, depending upon the weather.

Effect of Diameter of Cyclone

The purpose of this research was to determine the economic point from a commercial standpoint of various diameters of cyclones, since, theoretically, the smaller the cyclone, the higher the collection efficiency, but the higher the draft loss through the cyclone and the greater the initial cost of investment.

In these tests, the dust was contained in air at 80 deg. F. and careful determinations were made by means of Pitot tubes placed in the outlet straight run of ducts to determine the number of cubic feet per minute passing through each cyclone at various draft losses.

Fig. 2 shows a series of three curves indicating the capacity of cyclone and the efficiency of collection on the same material at varying draft losses with the 1 ft., 2 ft., and 3 ft. diameter cyclones of symmetrical design, the dotted portion of the curves being extrapolations. Due to the capacity of the fan, it was not feasible to run the 3-ft. cyclone at higher draft losses than those shown, but it will be noted from this curve that an optimum point is reached where the curve starts to flatten off and no important increase in collection occurred above this point.

With the 1-ft. cyclone, this optimum point is not reached until about 5.5 in., water gage. With 2-ft. cyclone, the optimum point is reached at 2 in., w.g. The 3-ft. cyclone reaches its optimum point at approximately 1.5 in., w.g.

Therefore, it is evident that, if for practical reasons, it is assumed that the cyclone collector should operate at approximately 1.25 in., w.g. draft loss, the best collection will be obtained with the 2-ft. cyclone in preference to either the 1-ft. or the 3-ft. apparatus.

The draft loss diminishes more rapidly than the corresponding reduction of gas volume, although it does not drop as the square. With low draft loss the collection efficiency likewise drops rapidly. For example (Fig. 2) if the 2-ft. cyclone normally operates with 1300 c.f.m. of air at 80 deg. F., it will produce a resistance of 2 in., w.g., and a collection of 86.5%. If the volume should drop to one-half this amount, or 650 c.f.m., the resistance drops to 0.75 in., w.g., and the collection to 72%.

This fact would have considerable importance in the collection of fly ash from boiler flue gas, due to the fact that there is usually considerable variation in boiler rating, and the collecting apparatus should be designed for maximum rating which would produce maximum dust loading in the gas and maximum gas quantity. If a boiler should vary between 300% maximum and 100% minimum rating, the collection would drop accordingly. Hence it would appear advantageous to control a series of small cyclones in parallel so that with half the quantity of gas only half the cyclones would be in operation, since the overall collection will be held at its peak by maintaining the design conditions as to resistance and gas quantity per cyclone. Automatic damper control could be easily arranged to maintain constant resistance through any group of cyclones in parallel.

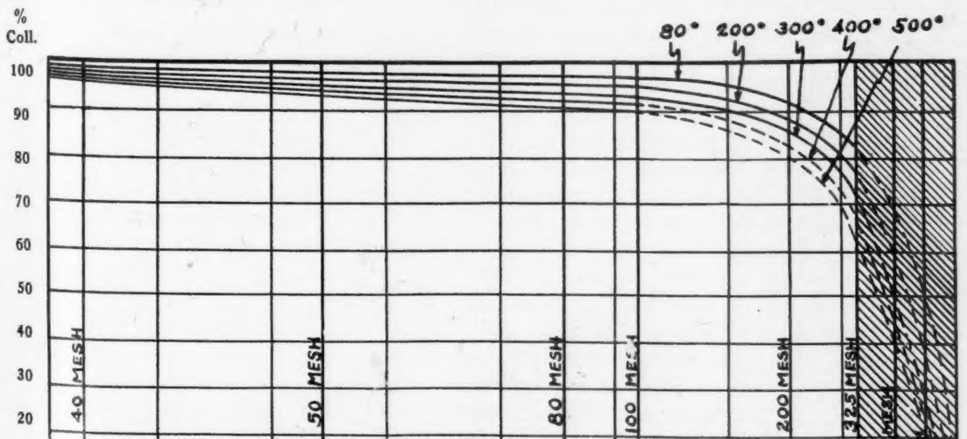


Fig. 4. Collection efficiency according to size and temperature with a 2-ft. diameter cyclone handling 1000 c.f.m.

The above figures, it must be remembered, are on a particular pulverizel-fuel dust and are of value for comparison. Fineness of dust, temperature of gas and real specific gravity of the particles will affect the collection at different draft losses.

Effect of Temperature

It is evident that the gas from which dust particles are to be collected may vary in temperature from atmospheric to relatively high temperatures over 1000 deg. F. Preliminary research indicated that collection was higher with cold gas than with hot gas, and this was justified by a study of Stokes law relating to the fall of a particle of dust through a layer of gas at dif-

ferent temperatures. This law is as follows:

$F = 6 \pi r \eta v$

F = the resistance of the fluid.

r = the radius of the particle, which is assumed to be spherical.

η = the coefficient of viscosity of the fluid.

v = the speed of the particle in relation to the fluid.

From this law it will be seen that the force which must be exerted upon a particle to force it through a fluid is directly proportional to the viscosity of the fluid.

Although the density of hot gas is less than the density of cold gas, the viscosity is considerably more, air being 1.24 greater at 212 deg. F. than 32 deg. F., and 1.44 at 392 deg. F. than at 32 deg. F.

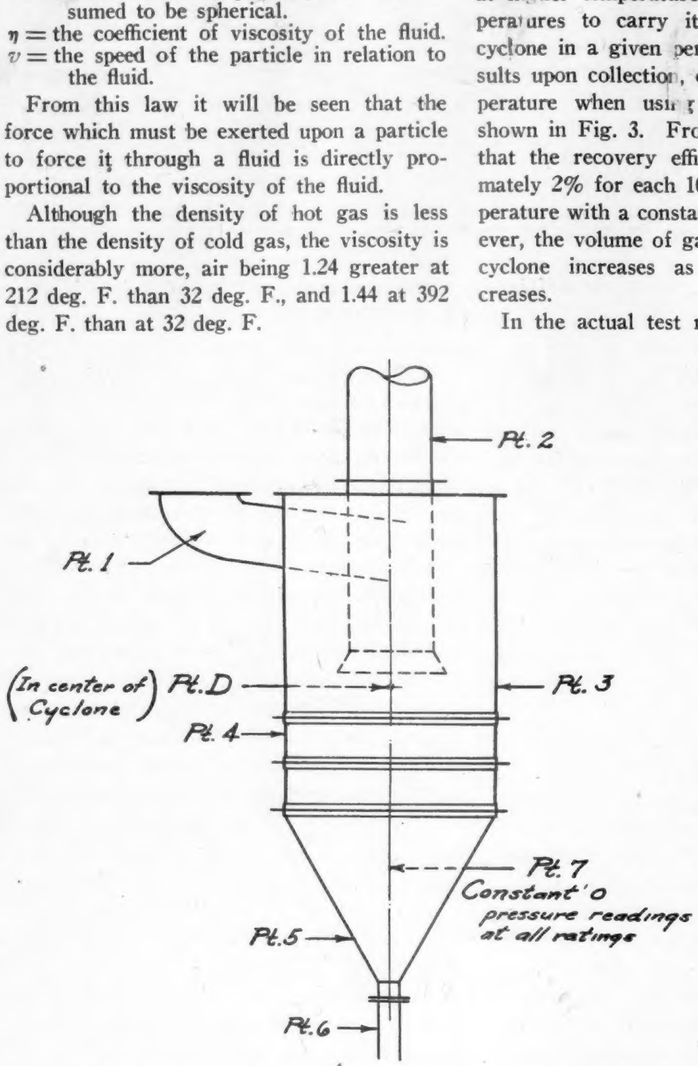


Fig. 6. Static readings within cyclone

From the above it will be seen that the centrifugal force which must be exerted upon a particle in a cyclone must be greater at higher temperatures than at lower temperatures to carry it to the wall of the cyclone in a given period of time. The results upon collection, of increasing the temperature when using a 2-ft. cyclone, are shown in Fig. 3. From this it will be seen that the recovery efficiency drops approximately 2% for each 100 deg. F. rise in temperature with a constant pressure loss. However, the volume of gas handled through the cyclone increases as the temperature increases.

In the actual test run, temperatures over 300 deg. F. could not be used because of the danger of destroying the cloth bag at the outlet. The curves for 400 deg. F. and 500 deg. F. are therefore extrapolated and have since proved approximately correct in actual practice.

Effect of Mesh of Dust

Since in most cases, from a commercial standpoint, it is not possible to determine the screen analysis of the dust that it is desired to collect before the installation is put in operation, it was desirable to determine the precise collection, for example, of dust which remained upon 100-mesh, dust which passed through 100-mesh but remained on 200-mesh, and dust which passed through 200-mesh and remained on 325-mesh. The collection of dust passing through 325-mesh was evidently varied, depending upon the ultimate fineness of the dust, and no precise results could be anticipated which would cover the entire field of dust.

In view of the above facts, it might be said that practically all predictions as to collection of dust when given as an overall collection can only be classed as guesses. Mechanical collectors are necessarily affected by the fineness of the dust and the overall collection can only be calculated from a knowledge of the collection that would be obtained with each specific mesh of dust. Since the finest screen which can be obtained commercially at the present time is 325-mesh with an opening of 43 microns, all dust which will pass through this mesh screen is of an unknown fineness. Scientific predictions as to collection of the amount of dust finer than 325-mesh, therefore, cannot be given. In other words, if a majority of this dust averages 10 or 15 microns (theoretically about 1000-mesh), it will have a different percentage collected than if the average is 30 or 35 microns (theoretically 400- to 500-mesh). Except by microscopic examination upon relatively few particles which is inexact for the whole, there is no satisfactory way for determining precisely the average fineness of the dust passing through the finest mesh screen now obtainable.

In this series of determinations a large quantity of dust was run through the Ro-tap so as to classify it in material coarser than 100-mesh, through 100- and on 200-mesh and through 200- and on 325-mesh.

Constant pressure differential and flow of air through the cyclone was maintained for the various meshes. From the large number of results obtained the curve, shown in Fig. 4, was devised for this particular cyclone using the pulverized fuel fly ash employed in the test.

The curve is arranged according to the diameter of the particles in microns and the screen sizes given are those corresponding to that of the U. S. Bureau of Standards.

The following observations are pertinent. The size of the opening or diameter of the particle decreases approximately inversely as the size screen mesh, thus:

U. S. Standard screen size	U. S. Standard in microns
50	279
100	140
150	104
200	74
250	61
300	46
325	43

On this same basis the size of particles can be calculated which would pass through theoretical 400-, 500-, 600- and finer meshes, which are too fine to construct. These would be approximately as follows:

Theoretical screen size	Theoretical micron size
400	34
500	27
600	23
700	19
800	17
900	15
1000	13.6

The curves in Fig. 4 must necessarily all reach zero collection before or at zero diameter, and the dotted lines shown beyond 325-mesh, or 43 microns, are estimations only. However, it serves to give some idea of the expected collection of 27-micron material

(theoretically 500-mesh) and 13.6-micron material (theoretically 1000-mesh). In the former case this would appear approximately 70% collection at 80 deg. F. and in the latter case 50% collection. As a matter of comparison it might be of interest to remark that red blood corpuscles are seven microns in diameter and that a 13.6-micron particle (considered as spherical and of silica) would float 13.8 miles in a 10-mile breeze from a 200-ft. height before reaching the ground, according to Stokes law.

Microscopic examination of cyclone-collected pulverized-fuel dust has shown that many of the small specks range from 10 microns to 1 micron by microscopic measurement, and it is interesting to note that they were actually capable of being collected, although to what extent cannot be estimated except as above.

However, by this curve an exact prediction can be given for dust larger than 325-mesh, if the granularmetric analysis is obtainable beforehand concerning the collection of similar dust in a similar cyclone.

Effect of Grain Loading of Dust

Theoretically the concentration of the dust in the gas should have no effect upon the percentage collection, due to the fact that each grain of dust is acted upon independently by the forces exerted upon it. The curve, Fig. 5, indicates that within the usual limits of grain loading ranging from 1 to 22 per cubic foot, there is practically no difference, as was to be expected. The slight rise for higher grain loadings is probably due to the fact that at these loadings some of the dust does not strike the cyclone walls proper, but is cushioned by other particles and thus is not subjected to as much breakage, and since breakage has a tendency to create a greater amount of fines, the less the breakage, the greater will be the amount of collection.

Effect of Arrangement of Outlet Pipe

Various shapes were designed for the outlet pipe which carried the dust away from the cyclone. It was found that an increase in diameter of the pipe at the outlet of the cyclone had an advantage over a straight pipe and acted somewhat in the nature of a check-valve preventing the dust at the bottom of the vortex, formed inside of the cyclone, from being drawn back with the current of air.

Effect of Rapid Emptying

This is closely related to the above observations. It was found that if 6.875 lb. of dust were allowed to remain in the 3-ft. cyclone, which was operated at 1.2 in., w.g., draft loss, handling 2450 c.f.m., there was a loss of 0.314% per min. It is, therefore, evident that it is an advantage to evacuate as much of the dust as possible, as rapidly as possible from the bottom of the cyclone by means of proper containers and a properly designed outlet pipe.

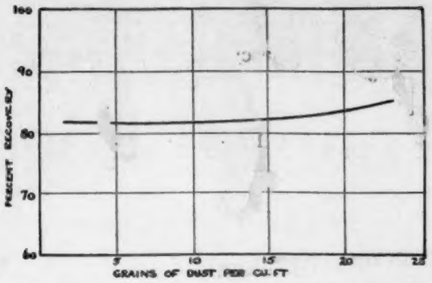


Fig. 5. Percent. recovery of fly ash in 2-ft. diam. cyclone handling 1000 c.f.m.

Exploration of Pressure Characteristics Within the Cyclone

It was considered of interest to determine the relative pressures within the cyclone when handling various quantities of gas. The static portion of a Pitot tube was considered the most accurate means of determining static pressures at various points within the cyclone. Referring to Fig. 6 and the series of curves beneath it, it will be seen that along the top of the cyclone a plus pressure is observed at points 2, 3 and 4, and that a minus pressure is observed at point 5 and 6 and point D. These figures are submitted primarily for their academic interest, although there was no particular practical interest that we were capable of deriving from these readings, except the following:

Since point 4 was uniformly plus, and point 5 uniformly minus, except at a low velocity of ½-in. or 1-in. where the reading was zero, we attempted to find the point where there would be a constant zero reading at all pressures by modifying the Pitot tube within the cyclone, between these two points, until such a point was observed. This constant zero reading appeared to be at a point 20 in. above the bottom of the cyclone cone on all observed readings of the cyclone.

Whether it is correct or not to conclude that this is the bottom of the vortex formed within the cyclone may offer some room for doubt, although this is probably the case. If this is the case, then it shows that the vortex does not move up and down the cyclone with different quantities of gas passing through it. We believe that the exploration of pressure characteristics within the cyclone offers a fertile field for academic research, and it is also to be hoped that the conclusions which are recorded in this paper will suggest further research concerning the operation of cyclone dust collectors which are becoming increasingly important because of the necessity of collecting dust and industrial waste in view of our more enlightened laws concerning public health.

Index to A. S. T. M. Standards Issued

THE INDEX to the American Society for Testing Materials Standards and Tentative Standards as of September, 1931, has been issued.

Medal Awards and Elections to Honorary Membership

THE board of direction of the American Concrete Institute announces the award of three honor medals for noteworthy contributions to engineering knowledge and the election to honorary membership in the American Concrete Institute of eight men who have important places in the progress of theory and practice in concrete construction. The honors will be formally conferred at the 28th annual dinner of the Institute.

To Duff A. Abrams, consulting engineer, New York City, who retires this year as president of the Institute, will be presented the Henry C. Turner gold medal, which is awarded not oftener than once each year for "notable achievement in or service to the concrete industry"—the special citation in the case of Professor Abrams being: "For the discovery and statement of important fundamental principles governing the properties of concrete and reinforced concrete." This is the fourth Turner medal since the founding of the award in 1928.

The Leonard C. Wason bronze medal, awarded each year since 1916 for "the most meritorious paper" presented at the previous annual convention, goes (duplicate medals) to Raymond E. Davis, professor of civil engineering, and Harmer E. Davis, instructor in civil engineering, both of the University of California, for their paper, Flow of Concrete Under the Action of Sustained Loads.

The Wason Research Medal is awarded to M. O. Withey, professor of mechanics, University of Wisconsin, for his 1931 Institute paper, Long Time Tests of Concrete.

Hitherto but two men have been elected to honorary membership: Richard L. Humphrey (deceased), president of the Institute, 1905,1914, and Adolf Buhler, chief engineer, National Swiss railways, Berne, Switzerland.

The eight newly elected honorary members are: Edward D. Boyer, cement expert, New York City; William K. Hatt, head, school of civil engineering, Purdue University; Robert W. Lesley, pioneer American cement manufacturer, Philadelphia; Arthur N. Talbot, professor emeritus in engineering, University of Illinois; Sanford E. Thompson, president, Thompson and Lichtner Co., Inc., Boston; Frederick E. Turneaure, dean, college of mechanics and engineering, University of Wisconsin; Henry C. Turner, president, Turner Construction Co., New York City; and Leonard C. Wason, president, Aberthaw Co., Boston.

Bill Permits Counties to Operate Gravel Pits and Quarries

A BILL has been introduced in the Virginia legislature permitting boards of supervisors to buy gravel pits and stone quarries and to sell stone and gravel to the state or to residents if these residents are not contractors and do not resell the stone or gravel.—*Richmond* (Va.) *Times-Dispatch.*

Engineering Methods Applied to Quarry Transportation

By G. D. Fraunfelder

Easton Car and Construction Co., Easton, Penn.

INTEREST in quarry transportation has been increasing and operators are learning its important effect on production costs. They also realize that engineering investigation is necessary to properly balance transportation with the other departments of a modern plant.

An outstanding example of what may be accomplished along this line is shown in the results obtained in the case of a large quarry producing cement rock. Previous records of the quarrying showed that when operating at its maximum capacity the haulage system was capable of handling 1400 tons, which required the hoisting and dumping of 200 cars in a 9½ hr. day.

This system, due to increased demand for the finished product, had to be changed to increase the tonnage to 2500 tons in the same length day and this article is written to show how time, study and engineering investigation increased the output with minimum expenditures.

The transportation system in use prior to the investigation consisted of a well-ballasted 36-in. gage track of 40 lb. rails on wooden ties, the system being divided into three distinct parts: the quarry floor, which was approximately level, with two gasoline locomotives; the 33% incline which used cable haulage, powered by an electric hoist with a rope speed of 600 ft. per min.; and the plant level haul to crusher, using two electric locomotives collecting current from a third rail. The cars were of the Easton Phoenix type, 5-yd. capacity, 36-in. gage, loaded by 1¼-yd. full revolving caterpillar type electric shovels. The cars on the quarry floor were moved between the shovel and the foot of the incline switch as single car units. The siding, which is shown in the accompanying layout, was used as a gathering point for all cars coming from the shovel and a starting point for loaded cars, a single car being hoisted to the top of the incline, where it was coupled to electric locomotives and moved to the crusher house.

Before the time studies had been completed several methods of increasing the capacity of the haulage system had been advanced. One was to install additional cars, and another was to handle two cars instead of one up the incline and to the crusher. These ideas were, however, impractical, since no additional cars could be placed in the already congested system, and both the electric hoist and electric locomotives were working to their capacity and could not continuously handle the load imposed by two cars.

A careful survey was made of each phase of the car movement by time study. This indicated that the best time that could be made on the incline for the round trip, loaded car up and empty down, including coupling time, was 1½ min, and that if permitted to work continuously on this basis the system would produce 380 cars, or 2600 tons in a 9½ hr. day, based on 7 tons to the car. Previous to this study it had been assumed that the incline was the limiting factor and the retarding point in the whole system, so that the results of the study opened up new possibilities.

Further studies showed that it took an average of 3 min. for the electric locomotives to make a round trip from the top of incline to the crusher house, or, since two locomotives were being used, a car every 1½ min. Therefore, the plant level haul by electric locomotives exactly balanced the round trip hoisting time of the incline.

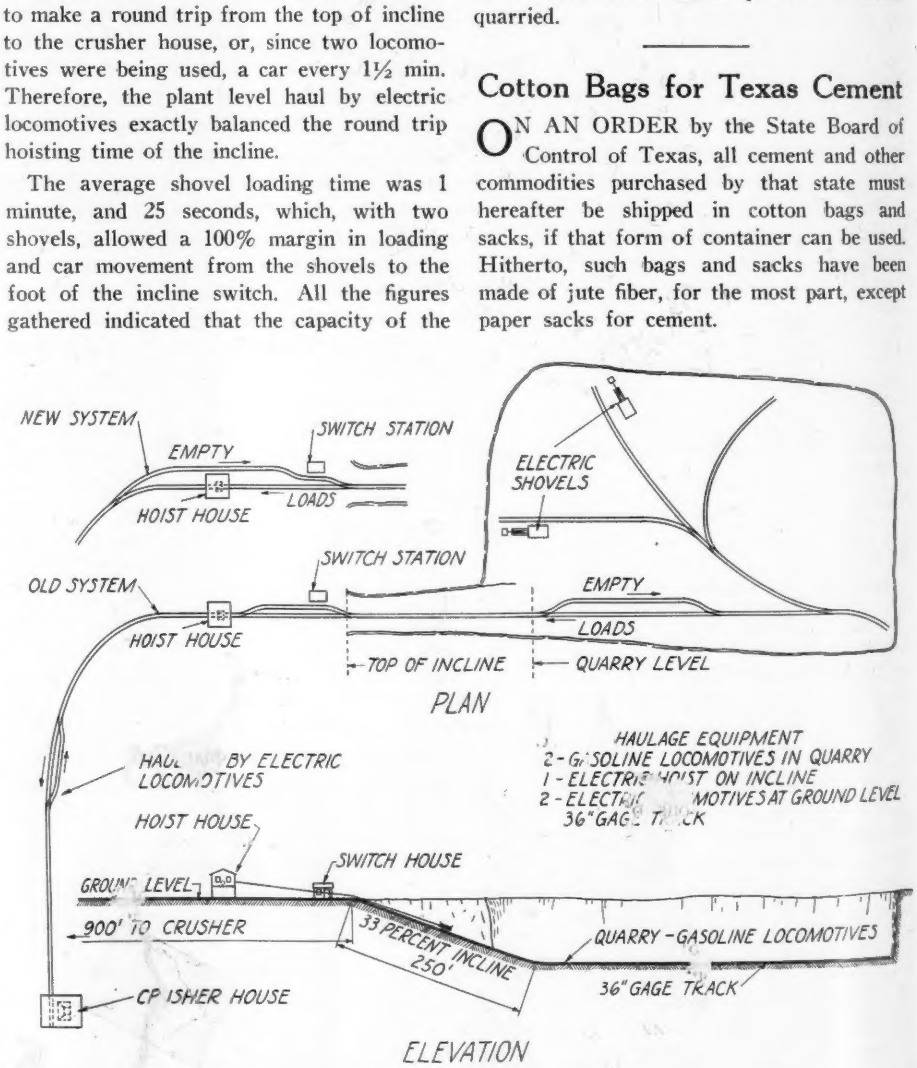
The average shovel loading time was 1 minute, and 25 seconds, which, with two shovels, allowed a 100% margin in loading and car movement from the shovels to the foot of the incline switch. All the figures gathered indicated that the capacity of the incline was limited and dependent upon the cycle of a car from the incline switch to the crusher and return, and that the gathering point should be changed.

Based on the above analysis, a longer siding was installed at the top of the incline, and the new system put into effect, with the result that the capacity was increased from 200 cars per day to 340 cars per day, or a total average capacity for the plant of 2400 tons in 9½ hours.

This particular operation is interesting because the capacity was increased 70% at a minimum expenditure by simply increasing the length of a siding and utilizing the same number of cars, locomotives and man-hour equipment. In addition, it resulted in a substantial reduction in cost per ton of stone quarried.

Cotton Bags for Texas Cement

ON AN ORDER by the State Board of Control of Texas, all cement and other commodities purchased by that state must hereafter be shipped in cotton bags and sacks, if that form of container can be used. Hitherto, such bags and sacks have been made of jute fiber, for the most part, except paper sacks for cement.



Plan and elevation of quarry showing old and new track layout

Illinois to Spend Forty Million on Highways, 1932

SPEAKING before the annual highway engineering short course at the state university, H. H. Cleaveland, director of the Department of Public Works of Illinois, declared a $40,000,000 highway construction program will be undertaken this year. One thousand miles of paving and work will be included in the program.

Expenditures will include items for construction of state highways, the paving, repairing and resurfacing of city pavements, maintenance of state and city roadways, policing of state highways, administration of motor fuel tax act, refunds to counties and allotments to the counties of their share of gas fees.

Mr. Cleaveland said downstate expenditures will approximate $28,000,000 and the Chicago area will benefit $12,000,000 in construction and resurfacing.

"The work downstate will be well scattered and will add many miles of new roads to the present system and also will insure the completion of gaps which now exist in various localities," Director Cleaveland said.

"New roads which will be built downstate during 1932 will offer outlets for communities which do not now enjoy the benefits of the paved system. About $1,500,000 of the $28,000,000 to be expended downstate will be spent on city streets which form extensions of state primary routes in that area.

"The program in the Chicago metropolitan area, comprising $12,000,000, will consist of widening of existing pavements, the construction of grade separations both with highways and railroads and the building of new 20- and 40-ft. roads. About $2,500,000 of the $12,000,000 will be spent on city streets forming extensions of primary routes in this area, of which $2,000,000 will be expended on streets inside the city of Chicago.

"The state expects to make every effort during 1932 to put the mileage remaining on the state primary system under contract, but in order to do so it will be necessary to secure the rights of way. The aid of the counties is solicited in obtaining these rights of way to make it possible to award the remaining work on the state primary system during 1932."—*Chicago* (Ill.) *Tribune.*

Increased Gravel Production in South Dakota

NEARLY 2,500,000 tons of gravel were excavated in South Dakota during the past year, according to reports. The production showed a slight increase over the last two years.

With the exception of a few variations, gravel production in South Dakota has steadily increased since 1915, and production has now reached the point where it is second in importance of the mineral industries of the state in value.—*Redfield* (S. D.) *Observer.*

States to Stop Gas Tax Evasion

ONLY RECENTLY was it discovered that bootlegging of gasoline has become so widespread that about one-fifteenth of all gasoline used in automobiles is sold in such a way that the prescribed gasoline taxes are not paid to the states.

Several states, when they became aware that many an unsuspecting motorist's dollar was making "successful" business men out of crooks, launched campaigns that have a twofold purpose; the placement of bootleggers behind the bars and of gasoline tax money in the proper receptacle, the state treasury.

Gasoline bootlegging, which is found in nearly every state regardless of the size of the gasoline tax rate, can be stopped and at a profit. In Illinois, for instance, the 1931 July-October collections were $728,000 more than in 1930, even though less gasoline was sold. Further, 50 tax evaders have been indicted and more will be soon. Pennsylvania is also playing a winning hand. In September, 1931, that state collected one-third more gasoline tax money than in the same month in 1930. Pennsylvania has more than 600 gasoline tax evasion cases pending in the criminal courts.

Gasoline bootlegging can be stopped. Motorists have permitted themselves to be taxed for the reason that they benefit through road construction, therefore government is morally responsible for all gas tax money.

Federal Road Work Well Distributed

"THE POLICY of the Federal government in distributing Federal aid funds so that the less populous and less wealthy states can also make noteworthy progress is in keeping with the spirit of the federation of states."

This statement was made by Frederic E. Everett, president, American Association of State Highway Officials, in commenting on the need for continued Federal aid in road building recently.

Mr. Everett further said: "Before anyone criticises the present method of distributing Federal road funds let him first consider the principles of the constitution, the character of the country and the country's needs. The secret of the strength of the United States lies in that word 'united.' It is the duty of the country as a whole to develop and guard its natural resources. The western states, for example, with their large public domain areas contain potential wealth of staggering volumes. It is a national responsibility to see that the West gets good roads along with other parts of the country.

"The United States is a complex nation. Its strength and progress depend upon its unity. Its unity depends upon its transportation."

Good Roads Association Makes Important Recommendations

EFFORTS to submit to popular vote next fall, two constitutional amendments affecting Nebraska state highway policy were assured as a result of action of directors of the Nebraska Good Roads Association February 11.

Besides approving submission of a $30,000,000 bond issue the directors voted to ask creation of a state highway commission in an effort to remove highway building from the political arena.

The proposed commission would be nonsalaried and bipartisan, to assure equal representation of opposing parties. The five members would be appointed by the governor.

The good roads directors chose to seek submission of the question by constitutional amendment as a result of failure to get the legislature to enact such a measure.

The bond issue resolution was drawn with several protective provisions not incorporated in previously suggested plans. One of these specifies that only such improvements be made where the cost of maintenance of a road is equaled by the carrying charges of the proposed bond issue.

It is designed to prevent "political paving" and to insure paving on roads with high maintenance cost where paving would be economical and soundly financed by the bonds.

A suggested program from the $30,000,000, drafted by E. H. Polley, executive secretary of the Association, shows that by January 1, 1938, Nebraska could have 2450 miles of paving, 1185 miles of oil gravel, and 6180 mi. of ordinary gravel, an addition of approximately 4000 miles of improved roads to what is expected will comprise the state's improved highway system at the end of this year.

The directors questioned the advisability of oil surfacing, pointing out that it costs a third as much as paving. A resolution was passed advising against oil surfacing until its durability has been given better proof. The opinion was expressed that the state should not spend money on unproved surfacings.—*Lincoln* (Neb.) *Star.*

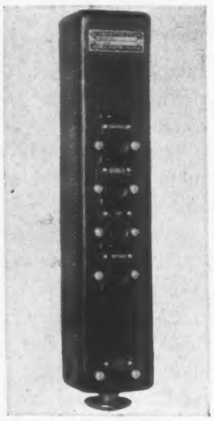
Bill to Control Sand and Gravel Dredging

A BILL has been introduced in the New York senate to liberalize the laws governing the conduct of the sand and gravel industry in Lake Erie. The measure provides that the commissioners of the state land office may authorize the removal for commercial purposes of sand, gravel or other materials found in deposit in the bed of Lake Erie, the title to which is in the state, and which lie at a greater distance than one mile from the shore line at low water mark. Such right to remove gravel and sand is to be limited to residents of the United States, using vessels registered from United States ports. —*Buffalo* (N. Y.) *Courier-Express.*

New Machinery and Equipment

Push Button Station

A NEW LINE of pendant-type, momentary-contact push button stations, designated Type CR-2940, has been announced by the General Electric Co., Schenectady, N. Y. The stations may be fitted with sufficient cable so that they can be carried around by a machine operator.



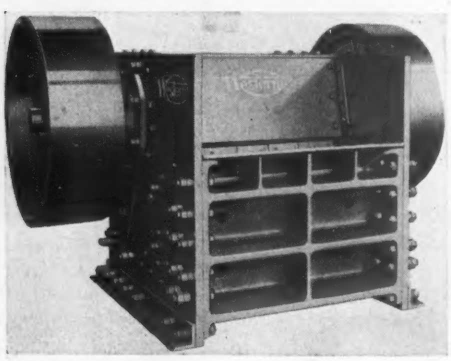
New pendant-type push-button station

The momentary-contact push-button unit provides both a normally-open and a normally-closed circuit. The units are mounted on the front of the case by means of screws, and are adaptable for mounting on the back of any cover-plate or may be built into a machine.

All of the buttons except the "Stop" button are protected from accidental operation by means of a guard at the bottom of the button. The "Stop" button is mounted on the bottom of the case and is easily accessible in case of emergency. A nameplate over each button indicates its function. The case is provided with a conduit knockout at the bottom, and any standard BX fitting with multi-conductor cable can be used.

Roller Bearing Jaw Crushers

THE AUSTIN-WESTERN Road Machinery Co., Chicago, Ill., announces two new "Western" roller bearing jaw crushers, for use both as separate units and in the new "Western" No. 100 and No. 90 portable crushing and screening plants. The "Western" No. 940 crusher has a jaw opening of 9 in. by 40 in., while the No. 440, which is generally used as a reduction crusher, has a jaw opening of 4 in. by 40 in.



Jaw crusher with roller bearings

Both of these crushers are of the overhead eccentric type, and it is claimed they produce large quantities of 1-in., or smaller, material, containing practically no oversize.

These crushers have plate frames said to be both stronger and lighter than cast frames, and main shafts of chrome nickel steel, forged and heat treated.

Self-aligning SKF roller bearings are used in these crushers and the manufacturer states, they permit the shaft to spring in any direction.

The pitman is a steel casting. Its upper end is bored to provide an accurate fit for the shaft bearings, while the lower end has a groove planed to receive the manganese steel toggle seat. The front face, which supports the moving die, is also planed.

The toggle is a high carbon steel plate. Stationary and moving dies are manganese steel, and reversible, while the cheek plates are made in sections to reduce replacement expense.

Welding Flux for Stainless Steel

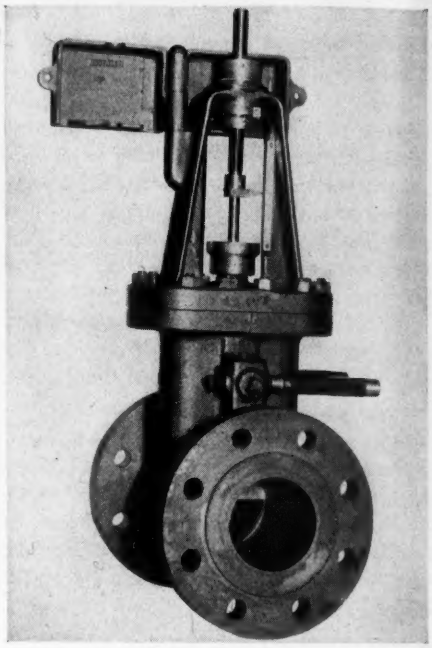
A WELDING FLUX developed especially for use in welding the chromium-containing alloys, more generally known commercially as stainless steels or rustless irons, and known as "Cromaloy" flux, is distributed by the Linde Air Products Co., New York, N. Y.

According to the Linde company, the ordinary fluxes used for welding or brazing are not satisfactory in welding stainless steel or rustless iron because they will not dissolve the infusible oxides. A satisfactory flux for use in welding these alloys must also be sufficiently fireproof to protect the molten metal and hot metal adjacent to the weld from oxidation, and at the same time correctly compounded to dissolve the refractory chromium oxide with ease, the manufacturer states.

Because of its high solvent power for chromium oxide, and its high resistance to heat, "Cromaloy" flux is especially prepared for this type of work.

Adjustable Orifice

FOR FLUID METER installations where it is desirable to obtain accurate measurements over a wide range of capacity, the Bailey adjustable orifice has been designed by the Bailey Meter Co., Cleveland, Ohio. This product is suitable for use with meters measuring gas or low pressure heating steam.



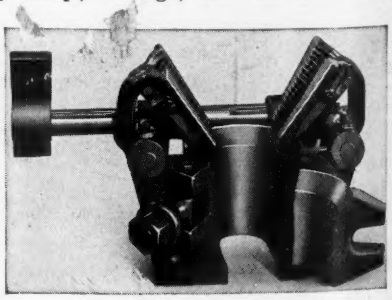
Orifice with micrometer adjustment

The adjustable orifice consists of a flanged body with integral meter connections. It can be readily installed in a steam, water or gas line and connected to any differential head type of fluid meter, the manufacturer states. The adjustable orifice functions similarly to the Bailey fixed type segmental orifice. According to the manufacturer, a micrometer adjusting screw permits setting the height of the gate segment within .001 of an in. When it is advisable to change the capacity of the meter, it is simply necessary to set the micrometer screw at the reading corresponding to the desired maximum capacity.

The adjustable orifice is said to permit changing the maximum capacity of the meter as much as 40 to 1.

Safety Clamp for Drills

A SAFETY CLAMP for diamond drills is announced by the Sullivan Machinery Corp., Chicago, Ill. These "Bulldog"



Drill clamp with safety feature

safety clamps are similar in operating principle to the "spider and slips" commonly used in the oil field for handling drill pipe or tubing.

The body of the clamp is roughly square in shape, with agate or hinged opening, enabling the clamp to be quickly put over the hole or removed from it while the rods are in the hole. The opening through the body of the clamp is circular, and forms a smooth, tapered bowl, of larger diameter at the top than at the bottom. The drill rod passes through the center of the hole and is gripped by "slips" or jaws. There are four of these jaws, arranged in pairs, having cut teeth, heat-treated on their inner faces, to engage with the smooth rod, and with their outer faces rounded and tapered to conform to the bowl. When the jaws are set, the weight of the rods tends to pull them down into the bowl, and the greater the weight, the tighter the jaws or "slips" grip the rod.

Each pair of jaws is hung on a swinging arm carried by steel shafts which are interconnected by geared segments and controlled by a single lever on the outside of the clamp. In the small clamp this lever is operated by a foot treadle. In the larger clamps, a removable hand lever is provided. By pushing downward on the handle, the jaws are raised to open them.

Advantages claimed for these safety clamps are, they provide greater strength and security with greater safety for the operator; secure increased ease and speed in setting and releasing the clamp, with less delay from sticking of the working parts; prevent injury through distortion, and reduce wear on the drill rods; are much lighter than earlier clamps; and the gate design enables clamps to be placed over the hole or removed from it while the rods are in position.

Drill Steel Sharpener

THE Gardner-Denver Co., Quincy, Ill., has increased its series of drill steel sharpeners with the introduction of the Model DS-6, a larger and more powerful sharpener.

New drill sharpener has scale blower

Equipment can be supplied for handling any size of hexagon, quarter octagon, or round steel. Double taper bits up to 3 in. on steel up to and including 1½ in. round can be forged and sharpened.

The machine incorporates a new and distinctive scale blower operated by a small lever placed on the right hand side of the machine within easy reach of the operator. A slight movement of this handle thoroughly cleans all scale from the dies, the manufacturer states.

Specifications on this machine give the height overall as 48¼ in.; weight 2000 lb., and diameter of round base 28 in.

Journal for Roller Mills

A NEW oil journal for Raymond roller mills is announced by the Raymond Bros. Impact Pulverizer Co., Chicago, Ill.

The journal assembly consists of four main parts, the shaft, the journal head, the housing and the roll. The main shaft is stationary and has an oil reservoir in the lower end. This reservoir is supplied with oil through a hole drilled in the center of the shaft. The journal head is set on a taper on the shaft and is held in place by a nut at the top. The revolving housing is made in two parts that are bolted together. The upper part telescopes into the journal head and forms a dust seal. The lower part is tapered and fits into the roll, which is held in place by a heavy nut. The combined revolving housing is carried by the collar on the shaft and the thrust is taken through the hardened thrust rings.

New oil journal uses centrifugal force

There is no stuffing box or seal ring employed to keep the oil in, but the journal is said to be constructed in such a way that centrifugal force and gravity act to prevent the escape of oil.

The oil is fed down through the center of the shaft and, due to the rotation of the roll, is pumped out and upward between the shaft and the bushings. There is an offset in the shaft near the top of the upper bushings and at this offset is an oil hole leading back to the center of the shaft. When the circulating stream of oil reaches this height, it is said to be forced inward by the centrifugal force created by the journal assembly rotating around the vertical mill shaft. Any oil that gets past this offset is forced downward by a spiral groove in the upper part of the upper bushing. The combination of the above forces causes a circulation of oil through the working parts of the journal, the manufacturer states.

The oil consumption is said to be practically nil, but in order to keep the oil in good condition some make-up oil is added every 48 to 60 hr. of operation. The journal is said to have no tendency for oil to overflow and leak, whether idle or in operation. Cost of repairs is also said to be negligible.

These journals can be installed alongside existing journals in any Raymond roller mill, the manufacturer states.

Locomotive Completes Test Run

THE Timken Roller Bearing Co., Canton, Ohio, announces that ball bearings are initial test run by the first locomotive ever to be equipped with anti-friction bearings.

The locomotive is equipped with Timken tapered roller bearings in all axles. The test run consisted of 100,000 miles on 14 different railroads.

Remarkable records were established on this test run it is stated, which demonstrate that maintenance economy is second only to reliability with locomotives so equipped. It is said a special issue of the *Railway Age* will be devoted to describing the construction and giving the performance figures of this locomotive.

Makes Large Scraper Bucket

A 14-cu. yd. Sauerman "Crescent" drag scraper has been delivered to the Brooks-Calloway Co. by Sauerman Bros., Inc., Chicago, Ill. The scraper is in service on a levee-building tower machine, having replaced a 12-cu. yd. "Crescent." It is 12 ft. 6 in. long, 11 ft. 6 in. wide and 7 ft. high.

Ball Bearings Standard Equipment on Motors

THE Lincoln Electric Co., Cleveland, Ohio, announces the termination of an now standard equipment on all its motors and that sleeve bearings will be supplied only on order.

Program of American Concrete Institute

THE tentative program for the 28th annual convention of the American Concrete Institute to be held in Washington, D. C., March 1-4, has been announced as follows:

March 1

9 to 2—Registration.

2 p.m.—Report of committee 502; report of committee 503; report of committee 506; two papers, Problems in the Design and Construction of Concrete in Major Irrigation Structures, by Byram W. Steele, civil engineer, U. S. Bureau of Reclamation, Denver; and Concreting Problems in the Chats Falls Power Development, by Col. H. L. Trotter, Fitzroy Harbor, and Wilfred Schnaar, Hydro-Electric Power Commission of Ontario, Toronto.

8 p. m.—Special Finish Concrete Sidewalks in Washington, D. C., is the subject of a proposed paper for which arrangements are not yet complete; Cast Stone as a Means to Color in Architecture, by Fred R. Lear, Department of Architecture, Syracuse university; Pittsburgh bridge design and construction with motion pictures; The Design of Concrete Arches in Allegheny County, by G. S. Richardson, assistant engineer of bridge design, Bureau of Bridges, Department of Public Works, Allegheny county, Penn.; and The Construction of Concrete Arches in Allegheny County, by V. R. Covell, chief engineer, Bureau of Bridges, Department of Public Works, Allegheny county, Penn., are papers to be read.

March 2

9:30 a. m.—The Structural Performance of Concrete Masonry Walls, by F. E. Richart, research professor of engineering materials, University of Illinois; The Effect of Mortar Strength on the Strength of Concrete Masonry Walls, by R. E. Copeland, engineer cement products bureau, and A. G. Timms, associate engineer research laboratory, Portland Cement Association; The Strength of Concrete Masonry Walls after Standard Fire Exposure, by C. A. Menzel, Portland Cement Association; and Properties and Problems of Masonry Cements, by J. C. Pearson, director of research, Lehigh Portland Cement Co., are papers to be given at this session devoted to concrete masonry.

There will be no session of the American Concrete Institute in the afternoon of March 20.

8 p. m.—The Design, Construction and Test of the Rogue River Bridge, by Albin L. Gemeny, senior structural engineer, Bureau of Public Roads, and C. B. McCullough, bridge engineer, Oregon state highway department; and Deflections and Vibrations in High Structures, by L. J. Mensch, engineer and contractor, Chicago, are papers to be read. Report of committee 105, reinforced concrete column investigation, will also be given.

March 3

Morning—The Bureau of Public Roads and the Bureau of Standards will be hosts to American Concrete Institute visitors.

2 p. m.—Business of the Institute; papers on Studies of the Workability of Concrete, by T. C. Powers, Portland Cement Association; New Studies of Light Weight Building Materials, by H. Herbert Hughes, building materials section, Bureau of Mines; The Effect of Vibration on Concrete—a progress report from committee 106, R. F. Leftwich, author-chairman; and Tests of Transit Mixing, by S. C. Hollister, professor of structural engineering, Purdue university, will be presented.

8 p. m.—Annual dinner.

March 4

9:30 a. m.—The Mt. Vernon Memorial Highway (Design), by R. E. Toms, principal highway engineer, Bureau of Public Roads, and (Construction), J. W. Johnston, district engineer, Bureau of Public Roads, a paper, will be read; Proposed Specifications for Concrete Pavements for Municipalities, report of committee 902, will be given and the program will be concluded with a paper, The Mortar Voids Method of Designing Concrete Mixtures, by Mark Morris, Iowa state highway department.

Afternoon—A tour of Arlington National cemetery and Mt. Vernon.

Road Building Needs Assured Funds

CONSTRUCTION of public improvements serves as an employment stabilizer, particularly when general business conditions develop sinking spells. In public construction, road building is the largest factor. Because of its importance road building should be unfettered, in so far as possible, by the whims of politics and emergency legislation which would curtail construction activities.

During the last year proposals have been made in various states and local communities which would lessen the money available for new roads. Fortunately, this movement has met with little applause or success and when the 1932 road building season opens probably almost as many men will be on road jobs as there were in 1931.

If the need for better roads were not so pronounced and the lack of good roads not so costly, proposals to divert or decrease road money, for instance, might be logical. But circumstances of the present and immediate future are such that the highway industry should not be in a position wherein it shudders every time lawmakers are called.

Road building, together with street construction, last year kept a million people working directly on projects which became of immediate cash value. Every dollar diverted from its intentional use on the highways means 85 cents directly taken away from workers. That is reason enough for using road funds for building roads.

Cites Unemployment Result of Curtailed Road Construction

THE ABRUPT CURTAILMENT of concrete road construction by the Pennsylvania department of highways in 1931 was partly responsible for a decrease of nearly 2,000,000 man hours of labor in the cement mills of the Lehigh Valley district, according to a survey just completed by the Allentown Chamber of Commerce. Statistics were supplied by eight manufacturers operating 12 plants.

"The facts, briefly, are these," reads a statement issued recently by the Allentown organization:

"In 1929, 17,131,237 bbl. of cement were produced in this area. In 1930, production dropped to 15,221,636 bbl., and in 1931 was down to 12,221,123.

"In 1929, the total production for the Pennsylvania department of highways' contracts was 558,355 bbl. In 1930, deliveries amounted to 992,993 bbl. and in 1931 they dropped to the low level of 219,567 bbl. In other words, Pennsylvania highway department contracts consumed three-quarters of a million less barrels in 1931 than in 1930.

"Our figures on total man hours in the cement industry of this district show 8,883,538 for 1929; 7,581,700 for 1930 and 5,759,983 for 1931. This is a reduction of 1,721,717 man hours in 1931 as compared with 1930. Curtailed production in two of our large mills from which data was not obtained would easily show the total reduction in this district to be in excess of 2,000,000 man hours. (This figure does not include loss in man hours as a result of decreased deliveries to Pennsylvania department of highways by mills in other sections.

"Carrying this a step farther, production statistics show that 136 lb. of coal are required to produce a barrel of cement. The more than three-quarters of a million barrels loss between 1930 and 1931 in highway contracts alone would have consumed 52,640 tons of coal in the making—coal that would have been mined in Pennsylvania by Pennsylvanians, and hauled to the mills over Pennsylvania railroads. To this could be added the many tons of limestone, gypsum and other cement ingredients, and the outgoing freight to all parts of the country. Continued production and shipments of these materials would have benefited general employment throughout the state."

Kansas Highway Department Hunts Silica Deposits

THE STATE highway department of Kansas is attempting to locate silica beds in McPherson county to be used for the construction of bituminous mat surface highways, commonly known as the "blotter" type.

L. L. Marsh, assistant material engineer of the state highway department, said such material can be found north of McPherson.
—*Salina* (Kan.) *Journal.*

Congress Considers Road Building for Unemployed Relief

CONGRESS is now considering several measures to effect unemployment relief through road building. These bills are non partisan and, according to congressional leaders, should receive the support of both parties.

"The importance of providing some sort of emergency appropriation with which the states can match federal aid during the coming year cannot be overestimated," states W. R. Smith, president of the American Road Builders' Association. "Without such emergency aid many of the states will not be able to utilize federal aid without seriously crippling maintenance and similar necessary highway activities. Every dollar spent for highway improvement lessens the amount that communities must raise for direct relief.

"States, counties and cities will follow the lead of the federal government in making road and street appropriations. Any decrease will result in additional unemployment in all sections of the country. Highway building is a widely-distributed and well-tested method of unemployment relief."

Canada Cement Co. Markets New Product

THE CANADA CEMENT CO., Ltd., Montreal, Que., is now manufacturing and marketing a new product known as Kalicrete, according to a statement made by J. D. Johnson, president, at the annual meeting of the stockholders.

This new product is an alkali-resisting cement. The company will market it in western Canada where, in certain districts, alkali salts are met with in concentrated form in the soil. The general characteristics of this product are similar to those in portland cement with special physical and chemical changes adapting it for the particular purpose for which it is intended.—*Toronto* (Canada) *Financial Post.*

Indiana Considers Cement Awards for 1932

AWARDING CONTRACTS for the Indiana state highway department supply of 2,000,000 bbl. of cement was under consideration February 10.

A proposal that the commission adopt a policy of awarding construction contracts to Indiana bidders rather than to foreign bidders regardless of whether an Indiana bidder is low, also was to be discussed. Governor Leslie is said to have proposed that Indiana bidders be favored in view of the labor and financial benefits that would accrue to the state. Among delegations visiting the commission was a group representing brick manufacturers of the state.—*Indianapolis* (Ind.) *News.*

Announces New Cement

BEDFORD STAINLESS CEMENT for laying brick, tile and setting stone and made by the Reardon Cement Co., at South Chicago, Ill., is now on the market. It is sold through building supply dealers. The producers state that this new cement represents the latest chemical and research advances of the past ten years, particularly the tests and findings of the Bureau of Standards in its tests on mortar conducted in connection with the American Face Brick Association.

The principals of the Reardon Cement Co. are William J. Reardon and Edward J. Reardon, who have been identified with masonry cement development and marketing for a number of years.

The following advantages are claimed for Bedford Stainless Cement:

(1) Portland cement base corrected to be nonstaining in contact with Indiana limestone; (2) finely ground and highly plastic for brick and tile mortar; (3) all materials are burned at high temperature in rotary kilns—no inert matter—completely hydraulic; (4) waterproofed with calcium stearate; and (5) process entirely controlled.

Kentucky Considers Division of Highway Revenues

ALTHOUGH much work has been stopped on city, county and state construction programs, due to reduced appropriations, lack of funds, etc., work of the Kentucky state highway commission goes along at a normal pace, due to revenue from the 5c. gasoline tax which continues to hold its own. This, with automobile and truck license taxes, is providing a steady source of revenue for highway building and maintenance. There has been a lot of talk regarding the present session of the legislature reducing highway funds available, by splitting up such funds for use of other state departments in an emergency. There are also bills before the legislature to allow the various counties a percentage of the gasoline tax funds for road work in each county, but plenty of opposition is being given to any and all suggestions for splitting the road fund, as roads are needed, and farmers are living in hopes of seeing the day when the main roads are completed and the smaller road construction will take them out of the mud.

Awards Contract for Plant Addition

CONTRACTS have been awarded for the construction of the new building of the Standard Silica Co. at Ottawa, Ill. The plant when completed will represent an expenditure of about $100,000. The company's regular employes, formerly working in the plant, will be used in the construction of the building.—*Gillespie* (Ill.) *News.*

Program of Spring Group Meeting of A. S. T. M.

ARRANGEMENTS have been completed for holding the spring group meetings of the American Society for Testing Materials in Cleveland March 7-11. Committee C-9 on concrete and concrete aggregates and committee D-4 on road and paving materials will participate.

On March 7 subcommittee X of C-9 on deleterious substances in concrete, subcommittee XII on measurement of materials mixing and placing concrete, subcommittee XV on admixtures, subcommittee XIII on curing of concrete, subcommittee XVII on conditions affecting durability of concrete in structures, subcommittee VI on design of concrete, subcommittee VIII on permeability tests of concrete, subcommittee XI on apparatus for testing, and subcommittee IX on specifications and methods of tests of aggregates, will meet.

On March 8 the following subcommittees of C-9 will meet: subcommittee V on definitions, subcommittee VII on strength tests of concrete, subcommittee I, advisory, and subcommittee II, technical. In the afternoon the committee proper will meet.

March 9 the subcommittees of D-4 and committee D-4 will meet.

Universal Atlas Adds to Cement Storage

THE Gifford-Wood Co., Hudson, N. Y., has been awarded the contract calling for the erection of 12 cement storage silos at Hudson by the Universal Atlas Cement Co.

The amount of the contract is $76,000. The operation calls for the erection in one group, of a battery of 12 silos, 25 ft. in diameter and 100 ft. high. Cement will be stored in these silos and the added storage capacity, R. A. Dittmar, manager of the Hudson plant of Universal Atlas states, will place this mill in an excellent position to render fast service to eastern points supplied by the plant.—*Hudson* (N. Y.) *Star.*

Advances W. A. Rosenberger

THE PANGBORN CORP., Hagerstown, Md., manufacturers of blast cleaning and dust collecting equipment, announce the advancement of W. A. Rosenberger to the position of chief engineer.

Mr. Rosenberger, a native of Switzerland, graduated in 1909 from the Polytechnikum at Zurich, and came to the United States.

For 20 years he has specialized in blast cleaning and dust collecting problems, making many valuable contributions, in the form of inventions and designs, to each.

Well known throughout the industry, the news of his advancement to chief engineer of the Pangborn Corp. will be received with pleasure by his many friends and acquaintances.

To Build Plant for Processing Nonmetallic Minerals

THE EARTH PRODUCTS CO., which has just been formed at Houston, Tex., will construct a plant to cost $150,000 to convert into commercial use a variety of nonmetallic minerals which are found in south Texas, according to E. G. Noxon, executive vice-president of the company. Plans call for a plant for bleaching earths, with a capacity for handling more than 300 tons daily. These are used in the bleaching of lubricating oils and for purifying vegetable oils.

The plant will also be used to process silica flour, high-temperature refractories, volcanic ash, barite, aggregates and natural color sands. The color sands are used in the manufacture of cast stone, stucco, plaster, etc.

In addition to Mr. Noxon, officers include W. W. Rodgers, president; Walter Morgan, vice-president, and Grace V. Noxon, secretary and treasurer.

Construction in Texas for 1932

PROJECTS already planned in Texas for 1932 will approximate $70,000,000, a recent report in the *Manufacturers Record* states.

This estimate is based on projects in Houston to cost $8,000,000 to $11,000,000; Fort Worth, $10,000,000; Dallas, $7,500,000; San Antonio, $7,000,000; Austin, $4,000,000; Beaumont, $750,000; Galveston, $500,000, and Panhandle communities, about $6,000,000. In addition, the state highway department plans to expend $32,000,000 for road construction during the year.

A considerable part of this will be spent for public works and improvements.

To Build Potash Refining Plant

THE Texas Potash Co. of Dallas, Tex., plans construction of a potash refining plant and mine unit at its potash beds near Odessa, to cost $2,500,000. The company owns 12,000 acres of land, underlaid with potash at workable depth. It has been making test-hole explorations of the property for some time past. The main shaft will be 2100 ft. deep. Mining operations will be started during the present year, officials of the company say.—*Wall Street* (N. Y.) *Journal.*

Buys Wilcox Sand and Gravel Company

THE Wilcox Sand and Gravel Co. plant has been purchased by P. P. Proctor and C. A. Swope, both of Grants Pass, Ore. Management of the plant will be taken over immediately by the new owners, with Mr. Swope acting as plant manager.

The name of the concern and the personnel of the plant will remain unchanged by the switch in ownership, Mr. Proctor said.—*Grants Pass* (Ore.) *Courier.*

To Make New Products of Rock Asphalt

THE UVALDE Rock Asphalt Co. has completed and will place in operation soon a plant at Houston, Tex., for the manufacture of new lines of flooring, surfacing and other products. They will be made of a composition of 3 to 10% cotton fiber mixed with finely pulverized rock asphalt, which will be obtained from the company's large deposit near Uvalde. To this will be added a small quantity of pure liquid asphalt. One of the products will be in the form of plastic planks for use in bridge floors, railroad crossings, industrial floors and similar purposes. Another product will be paving tile, especially adapted, it is asserted, for floors in industrial plants, warehouses, cotton compresses and wharves. The third product, which will be manufactured a little later on, will be plastic flooring tile of various colors for use in office buildings, hospitals, schools and other buildings, and ultimately, according to the plans of the company, it will manufacture roofing shingles with the same composition.

Canadian Company to Specialize in Silicate of Soda

THE FIRST and only Canadian company exclusively devoted to silicates of soda, National Silicates, Ltd., head office at Brantford, Ontario, has just been organized and commences operations immediately, according to announcement. A joint subsidiary of G. F. Sterne and Sons, Ltd., of Brantford, Ontario, and the Philadelphia Quartz Co., Philadelphia, Penn., the new Canadian company will be exclusively devoted to marketing and developing all types of silicate of soda used in industry, now estimated to number more than 30.

Plans Gravel Plants in Texas

W. G. THOMAS, former superintendent for Horton and Horton, Houston, Tex., in partnership with P. R. Gassiott, has leased several hundred acres of gravel land four miles west of Eagle Lake on which a new gravel pit will soon be opened.

The new firm, in connection with its road gravel shipment work, expects to operate two washed gravel plants.

The new firm hopes to get machinery installed and begin operations soon.—*Eagle Lake* (Tex.) *Headlight.*

Reports 1931 Busiest Year

THE Kuster-Waterbury rock-crushing and sand plant, Corona, Calif., has had the busiest year in its history, and a crew of men has been employed steadily.

State engineers of the highway department have given the Kuster-Waterbury concern numerous compliments on the high quality of material it is producing from its Corona plant.—*Riverside* (Calif.) *Enterprise.*

G. E. Warren Opens Association Office in San Francisco

TO TAKE general supervision of association activities on the Pacific Coast, George E. Warren, assistant general manager of the Portland Cement Association, has established an office in San Francisco, at 564 Market street.

Mr. Warren comes from the general offices in Chicago, and will remain in this city. He has held his present title for 11 years and has spent the last 17 years in the industry, holding membership in the American Society for Testing Materials as well as in the American Society of Civil Engineers.

Simultaneous announcement has been made of the appointment of J. E. Jellick, formerly Pacific Coast manager, as district engineer for the northern and central California territory, with headquarters at the San Francisco office.—*San Francisco* (Calif.) *Examiner.*

Universal Gypsum Wins Safety Trophy

FOR THE SECOND consecutive year the Akron, N. Y., plant of the Universal Gypsum and Lime Co. has won the trophy in the accident prevention campaign conducted by the Associated Industries of New York State, Inc. The operations at this plant consist chiefly of the mining and processing of gypsum and the manufacture of gypsum wallboard.

Douglas C. Jeffrey, superintendent of the Akron plant, states that the plant has now operated over 900 days with no loss of time to a single man on account of accident.

Muskegon to Be Distributing Center for Western Michigan

MUSKEGON'S harbor has been selected as the new western Michigan distribution center of the Inland Lime and Stone Co., subsidiary of the Inland Steel Co. of Indiana Harbor, Ind.

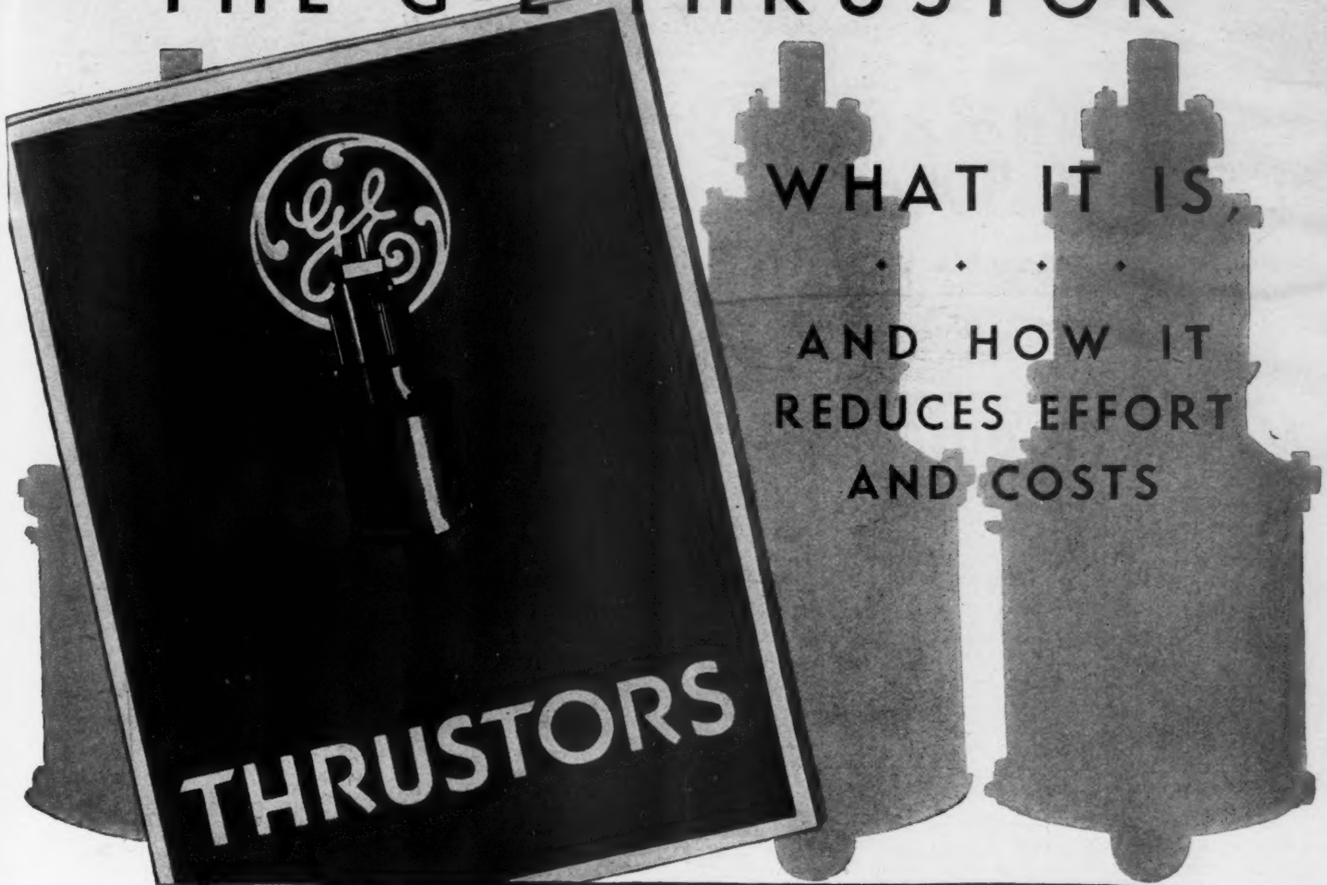
Stone will be handled by the Great Lakes Foundry Sand Co. of Detroit, over the Construction Materials Co. dock. It will be shipped throughout western Michigan by rail at a considerable saving to foundries and blast furnaces previously receiving the stone by rail from Indiana Harbor or Detroit.—*Kalkaska* (Mich.) *Leader.*

Lone Star Cement Co. Alabama Has Fire

CONSIDERABLE LOSS was suffered recently by the Lone Star Cement Co. at Spocari, Ala., when fire destroyed the office, supply room and laboratory.

Supplies, laboratory equipment, office equipment, and records were damaged. The total amount of loss is thought to be in excess of $50,000.—*Demopolis* (Ala.) *Times.*

THE G-E THRUSTOR



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